1990 Insect Pest Management Guide

FIELD and FORAGE CROPS

Intent of This Publication

This publication addresses pest management guidelines and alternatives for insects that attack field and forage crops in Illinois. Where practical, **nonchemical control** measures that have proven effective are discussed and strongly encouraged. However, **insecticides** are frequently the only and most efficient tool for responding to insect pest outbreaks. We recommend that insecticides be used only to supplement a completely **integrated pest management (IPM)** program that also includes the use of cultural, mechanical, and biological control tactics.

IPM has been defined as the selection of management practices that promote favorable economic, ecological, and sociological outcomes. In this context, insecticides should be used only after all other effective insect control alternatives have been explored. Furthermore, insecticides should be used only when an insect population has reached or exceeded an **economic threshold** — that level of a pest population when control should be implemented to prevent economic yield loss (projected cost of damage is greater than the cost of control). Then, before one makes a decision to use an insecticide, potential **risks and benefits** should be evaluated. Risks to human health and safety, as well as environmental risks, such as the potential for surface or groundwater contamination and wildlife destruction, should be carefully considered along with the economic benefits of insect control with insecticides.

The insect management practices that are discussed in this publication are based on research results from the Illinois Natural History Survey, the University of Illinois College of Agriculture, other land-grant universities, and the United States Department of Agriculture. Insecticides suggested for use have been registered by the U.S. Environmental Protection Agency (EPA). The information within this publication is revised annually and is intended for use during the current calendar year only.

Contents

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Information Resources

Information about publications and educational meetings dealing with insect management in field and forage crops is available from your county Extension office or from Extension Entomology, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820; telephone (217)333-6652.

Insect Fact Sheets

Fact sheets (designated by NHE numbers) that discuss nonchemical control methods and give descriptions of specific insects and their life history and biology have been prepared for most of the insects that attack field and forage crops in Illinois. Color picture sheets are also available in this series. Individual fact sheets and color picture sheets are $.25 each.

Insect Pest Management Guides

Other insect pest management guides available are Circular 897, *Insect Pest Management Guide: Commercial Vegetable Crops;* Circular 898, *Insect Pest Management Guide: Livestock and Livestock Buildings;* Circular 900, *Insect Pest Management Guide: Home, Yard, and Garden;* and Circular 1242, *Insect Pest Management Guide: Stored Grain.* Copies of these circulars are available from the Office of Agricultural Publications, address below.

Illinois Pest Control Handbook

All of the above-mentioned circulars, other references regarding management of insects, weeds, plant diseases, and vertebrate pests (including rats and mice), and pesticide application guidelines are bound together annually in the *Illinois Pest Control Handbook.* This is a valuable reference for pesticide dealers and applicators, farm managers, and anyone who frequently must answer questions about pest control. This publication can be obtained from the Office of Agricultural Publications, 69 Mumford Hall, 1301 West Gregory Drive, Urbana, Illinois, 61801; telephone (217)333-2007.

Field Crop Scouting Manual

The *Field Crop Scouting Manual* contains information relating to disease, insect, and weed identification, scouting techniques, and economic thresholds. A section on alfalfa insects has been added to the revised edition, as well as identification keys for seedling broadleaves and grasses. Picture sheets and line drawings are provided for many diseases, insects, and weeds that affect field crop production. Corn and soybean management guides that will assist crop consultants in diagnosing pest problems throughout the growing season are also provided.

Insect Management Alternatives

The series "Alternatives in Insect Management" (Circular 1295, *Alternatives in Insect Management: Microbial Insects,* and Circular 1296, *Alternatives in Insect Management: Botanical Insecticides and Insecticidal Soaps*) describes insect control methods that do not involve conventional insecticides. While synthetic chemical insecticides provide many benefits to food production and human health, they also pose some hazards. In many instances, alternative methods adequately control insects and pose fewer hazards. The publications in this series discuss the characteristics and relative strengths and weaknesses of available alternatives. This series of publications is available from the Office of Agricultural Publications (see address and telephone listed previously).

Insect, Weed, and Plant Disease Survey Newsletter

The *Insect, Weed, and Plant Disease Survey Bulletin* is issued weekly from April through August. This series of newsletters provides a timely look at the agricultural insect, weed, and plant disease situation, along with suggested control measures. New developments in pesticide application are also included. To subscribe to this valuable newsletter, contact the Agricultural Newsletter Service, 116 Mumford Hall, 1301 West Gregory Drive, Urbana, Illinois 61801; telephone (217) 333-2666.

Illinois Agricultural Pesticides Conference

The Illinois Agricultural Pesticides Conference is held annually in early January on the campus of the University of Illinois. The conference deals with current issues surrounding the use of agricultural pesticides and encourages the proper, timely, and wise use of pesticides within an integrated crop management system. It is a public meeting for anyone in agriculture who has an interest in using pesticides in a crop pest management program.

Printed proceedings from this conference are available from Extension Entomology (see address and telephone listed previously). This 200-page reference contains about 40 articles concerning recent research information about insect, weed, and plant disease management and about recent advances in pesticide application technology.

Sixteenth Annual Illinois Crop Protection Workshop

The Illinois Crop Protection Workshop is an annual program (March 13 to 15 in 1990) that provides the latest crop management information to agronomists, agrichemical representatives, county Extension advisers, crop consultants, farmers, farm managers, pesticide dealers and applicators, seed company representatives, soil conservationists, and anyone who has an interest in agricultural and environmental issues. Specialists provide in-depth discussions, educational materials, and "hands-on" exercises in specialized sessions regarding the biology and pest management strategies for insect, weed, and disease problems that occur in Illinois crops. General sessions provide challenging and far-ranging topics that affect a large cross-section of those involved in agriculture.

Field Crop Pest Management Short Course

The Field Crop Pest Management Short Course is an annual program (March 19 to 21 in 1990) designed to train personnel that will be monitoring field crops for diseases, insects, and weeds. The latest scouting procedures and field sampling techniques are discussed by specialists from each of the pest management disciplines. Pest identification, plant injury symptoms, and economic thresholds are discussed in detail in a laboratory setting. A general session provides information on nutrient deficiency problems, as well as a discussion on the growth and development of corn and soybeans. All participants who successfully complete the short course receive a certificate of achievement.

Pesticide Applicator Training Clinics

Commercial pesticide applicator training and certification clinics are offered annually at several locations throughout Illinois. Training for the General Standards exam and several commercial applicator categories are offered for applicators seeking to become certified. University of Illinois personnel provide the training and updates, and representatives from the Illinois Department of Agriculture oversee the testing. Study guides for the General Standards category and most of the commercial applicator categories are available at each clinic and through the county Extension offices or Extension Entomology. Contact Extension Entomology (see address and telephone listed previously) for information about dates, times, and locations for the various clinics.

Decision-Making for Insect Management

In order to successfully manage an insect population affecting a field crop, one must make many decisions. These decisions should reflect the long-term interests of the producer and the environment and may be very complex. Populations of insects (both beneficial and damaging species), weeds, and plant diseases interact with the crop and the abiotic (nonliving) component of the environment. When one also considers the bewildering complexity of crop production practices such as tillage, crop rotation, use of cover crops, crop variety, and type of fertility program, careful planning and considerable information are necessary to understand how a decision may influence a pest outbreak.

Integrated Pest Management

Weeds, plant diseases, and certain insects are pests because they compete with humans for food and fiber. The term "pest" is a label given to these competing organisms, but it has no ecological significance. Although

the routine use of pesticides has become a standard practice for reducing pest populations, certain problems arise from a sole reliance on pesticides. Because of growing concerns regarding insecticide resistance, secondary pest resurgence, and threats to public health in the 1960s and 1970s, the philosophy of integrated pest management (IPM) originated. In the 1980s, concerns over groundwater contamination and pesticide residue levels in food continue to emphasize the need for judicious use of pesticides. More than ever, IPM methodologies are vital for a sustainable national agricultural program and for environmental protection.

Insect populations in field crops react to the same fundamental ecological principles that influence interactions of plants and animals in natural ecosystems. Agroecosystems have much less diversity of species (beneficial organisms, plants, and pests) than occurs in a forest or a prairie. Consequently, a field crop is more susceptible to a pest outbreak because of this lack of plant and animal variety. The quick and often unpredictable alterations inflicted by changing weather and crop production practices can also trigger a sudden increase in a pest's population.

IPM programs promote favorable economic, ecological, and sociological outcomes. In order to accomplish this challenging goal, agricultural scientists have attempted to modify the life systems of insects, weeds, and diseases. As the term "integrated" implies, this objective is accomplished best by blending pest control tactics. The following cultural methods are often components of a successful IPM program: (1) use of resistant crop varieties, (2) crop rotation, (3) changing tillage practices, (4) variation of planting or harvest dates, (5) proper fertilization, (6) proper sanitation, and (7) use of trap crops. In addition to these cultural tactics, other pest management techniques such as biological control, genetic manipulation of pests, and the use of pesticides can be interwoven effectively into a complete program.

Economic Thresholds

In order to effectively manage an insect population, one must thoroughly understand the insect's life cycle and biology, as well as its potential to cause economic loss. People who attempt to put this knowledge to use by reducing an insect's population below a certain threshold are practicing an applied ecological approach.

The use of appropriate scouting tactics, proper identification of pests, and the use of thresholds are fundamental components of a sound IPM program. The economic threshold (ET) is that level of an insect population that indicates that control tactics should be used to stop a pest population from increasing further, thereby preventing economic losses. Economic thresholds may be expressed as numbers of insects — average number of potato leafhoppers per sweep in an alfalfa field — or as a level of damage — 5 to 10 percent of soybean pods injured within a field. The population level of a pest that is sufficiently high to cause economic damage to a crop is referred to as the economic injury level. The economic threshold is often referred to as the "action threshold" because control measures are usually employed when the insect population reaches this level to prevent the pest population from reaching the economic injury level.

Many years of research are required before carefully defined economic thresholds can be developed. Most currently used thresholds are simplistic and do not incorporate multiple pest densities into the decision-making process. More comprehensive economic thresholds should incorporate multiple pest densities, abiotic plant stresses (moisture stress, nutritional deficiencies, compaction, etc.), and unique agronomic practices into the decision-making process.

Neither environmental nor economical conditions are stable, and several factors may alter an economic threshold: (1) value of the crop (as the price paid for the crop increases, the economic threshold decreases), (2) cost of control (as the cost of control increases, the economic threshold also increases), and (3) crop stress (as the amount of stress on a crop increases, the economic threshold may decrease). For example, an insecticide may be economically justified for an insect pest population below the economic threshold if the crop is under stress from a lack of moisture, severe weed pressure, a plant disease, or a lack of proper fertility. Economic thresholds should be adjusted to comply with changes in market prices, cost of control, and the level of stress the crop is experiencing.

The use of an economic threshold and an economic injury level assumes that some knowledge of the average population density of an insect over time is known. Many insects are not pests. Populations of these insects in cultivated crops never reach a level sufficiently high to cause an economic loss. Occasional pests may reach the economic injury level when environmental conditions are favorable for an increase in the insect's density. For example, hot and dry weather favors outbreaks of spider mite populations during the growing season. Other insect populations are perennial, that is, their economic injury level is not much above their average population density. Certain agricultural pests fall into this category and, therefore, require carefully designed integrated management programs to keep their levels below the economic injury level.

Although much research is required before carefully defined comprehensive economic thresholds can be developed, producers should not be discouraged from beginning an IPM program. Comprehensive economic thresholds need not be available before progress can be made. More realistically, simple action thresholds can at

least serve as starting points for an IPM program. Knowledge of these commonly used simple economic thresholds will likely prevent many needless applications of pesticides.

Field Scouting

The use of economic thresholds requires that fields be monitored for insect populations, both beneficial and potentially harmful species. A successful pest management program hinges on these population estimates. Recognizing various pests and their damage is becoming increasingly important from an economic and environmental perspective. Pest scouting has been accepted by many Illinois farmers, and scouting programs are currently offered by private consulting firms, farmer cooperatives, pesticide dealers, and seed companies throughout the state.

The following questions should be considered by a producer when he or she is thinking about a scouting program or hiring a crop consultant: (1) Do you have the time to scout?; (2) Do you know how and when to scout?; (3) Can you identify insect pests?; (4) Can you identify beneficial insects?; (5) Can you accurately sample insect populations, at least well enough to feel comfortable with your decisions?; (6) Can you accurately measure crop damage?; (7) Do you know and understand economic thresholds?; (8) Do you know all of the insect-control alternatives?; and (9) Can you prepare a thorough set of crop scouting records? If a producer answers "no" to most of these questions and would like to begin an active IPM program, the services of a professional crop consultant should be considered. By enrolling in numerous IPM educational programs offered by the Cooperative Extension Service, producers can soon learn the latest crop monitoring techniques and begin scouting their own fields.

Tillage and Crop Rotation

Tillage practices may have direct or indirect effects on soil organisms. Type of equipment, timing (fall or spring), depth, and frequency of tillage operations are variables that can dramatically influence the survival of some insect species. An insect's unique reaction to changes in soil temperature, soil moisture, aeration, organic matter content, and bulk density of the soil may be regarded as direct effects on an insect's survival. Often of greater importance to an insect population are the indirect effects occasionally associated with certain tillage systems. For example, poor weed management practices in some tillage systems increase specific insect populations (black cutworms, stalk borers). However, it is not appropriate to make sweeping predictions about how all insects are likely to respond to a certain tillage practice. Insect biologies vary among species, as do their responses to various tillage practices, rotations, and cover crops.

Crop rotation greatly influences whether a soil insect problem may occur. The complex of insect pests will change according to the type of crops rotated, sequence of the crop rotation, and the amount of time devoted to the production of a particular crop prior to the planting of a new crop. The brief summaries that follow are designed to aid the producer in the decision-making process concerning the likelihood of an insect outbreak based upon the crop rotation used.

Corn after grass sod. Corn billbugs, sod webworms, white grubs, and wireworms may cause stand reductions when corn follows bluegrass, brome, fescue, rye, or wheat. If a producer decides to plant corn into an established field of grass sod, an insecticide at planting should be considered for the control of wireworms and white grubs because rescue treatments are not effective. If a stand is being seriously thinned by wireworms or white grubs, the only option is to replant and apply an insecticide during the replanting operation.

Corn after soybeans. The potential for soil insect problems in corn after soybeans is generally low, and the use of a soil insecticide is not recommended. A lindane or diazinon + lindane planter-box seed treatment will be adequate to protect the seeds against seedcorn beetles, seedcorn maggots, and wireworms.

Corn after corn. The potential for rootworm damage is moderate to severe wherever corn follows corn in Illinois. A rootworm soil insecticide may be needed in fields of corn after corn.

Corn after sorghum. A planter-box seed treatment of diazinon or diazinon + lindane will protect the seeds against seedcorn maggots.

Corn after small grain. There is a slight potential for damage by wireworms, seedcorn beetles, and seedcorn maggots in corn after small grain, particularly wheat. In most instances, a diazinon + lindane planter-box seed treatment is adequate. Excessive weed cover in small-grain stubble may have been attractive to northern corn rootworm beetles for egg-laying as the beetles moved from adjacent fields of drought-stressed corn.

Corn after legumes. Cutworms, grape colaspis, white grubs, and wireworms occasionally damage corn planted after clover and alfalfa. In addition, adult northern corn rootworms are sometimes attracted to legumes or to weed blossoms in legumes for egg-laying, especially in years when beetles are forced to leave adjacent fields of drouth-stressed corn to seek food. The use of a seed treatment is recommended, but producers may consider the use of a soil insecticide for this cropping sequence.

By comparison with research efforts on corn insects, much less research has focused on the influence of various cultural practices on soybean insect populations.

Most soybean insect pests are defoliators or pod feeders. These insects are often very mobile; some immigrate from other regions, and most move readily from field to field. The influence of a single soybean producer's unique tillage practices has often been viewed as insignificant in terms of increasing or decreasing the likelihood of pest damage caused by defoliators. Recently more research has been directed toward evaluating the potential effect of various tillage practices, crop rotational schemes, and cover crops on insect populations affecting soybean production. As results from many of these experiments are examined, it is obvious that the use of cover crops, tillage, and rotational sequences have different effects on many species of soybean insect pests.

Preventive and Rescue Insecticide Applications

After a thorough consideration of various IPM tactics, field scouting techniques, economic thresholds, and estimates of the likelihood of an insect outbreak, a producer must weigh the benefits of a preventive insecticide application against a "rescue" treatment. Each year a farmer must estimate the potential for insect pests to cause economic loss before deciding whether to apply an insecticide. If the odds are very high that a certain insect has the potential to cause an economic loss in most years, a producer is likely to use a preventive insecticide application. The following are some key factors that a grower must assess in determining the probability of an insect outbreak: (1) crop rotation; (2) nature of insect problems over the years (perennial or occasional); (3) type and timing of tillage practices; (4) density of overwintering insect population; (5) density of spring weed populations and, for certain insect pests, the fall population of weeds; and (6) weather.

If the decision to use a preventive insecticide application is made by the producer, several questions should be pondered very carefully.

- Is the insect you want to control listed on the insecticide label?
- Does the label suggest that the insecticide will control the insect, or do the phrases "suppression" or "will control low to moderate populations" appear?
- Will the insecticide selected provide acceptable control of the insect? Are you familiar with university research and recommendations?
- Is the recommended rate of application economical for your operation?
- Where should you place (band, furrow, broadcast) the insecticide to control the insect?
- How toxic is the insecticide? Is it a restricted-use insecticide?
- Should you use a granular or liquid formulation?
- Will the insecticide pose any potential hazards to the environment? If so, are there any better alternatives?

Many producers continue to rely very successfully on "rescue" insecticide treatments for certain insect pests as part of their overall farm management program. This approach has worked very well with black cutworms throughout the state of Illinois. Producers are made aware of the intensity of black cutworm moth flights in their counties and are provided with good scouting information and economic thresholds. If cutworms reach damaging levels, insecticides can be used as postemergence treatments.

Nonchemical Control Alternatives

When making a decision regarding how to effectively manage an insect population, growers are encouraged to examine nonchemical approaches. What are these alternative approaches, and how available are they?

Through a process referred to as "natural control," certain insects and diseases suppress populations of pest insects without our help. For example, European corn borer populations are often reduced by *Beauveria bassiana,* a fungus, or by *Nosema pyrausta,* a protozoan. These diseases are part of the natural ecosystem and exert their influence without human intervention. Through a process more appropriately called "applied biological control," predators, parasites, or disease pathogens are introduced into the agroecosystem artificially. Although much research has been conducted, the introduction of beneficial insects and disease pathogens into corn and soybean fields to control pest insects has not fared well. These environments are constantly changing, so beneficial organisms have a difficult time becoming established. Success stories in applied biological control are most often associated with more stable environments like forests. This is not to say that we shouldn't continue to explore and conduct research on promising opportunities for applied biological control in field crops. However, the practical implications of releasing predators, parasites, or insect pathogens have not been borne out in row crops in the Midwest.

The use of microbial insecticides currently offers considerably more potential within an IPM program. Microbial insecticides are made of microscopic living organisms (viruses, bacteria, fungi, protozoa, or nematodes) or the toxins produced by them. These insecticides can be formulated to be applied as sprays, dusts, or granules. The chief advantage that microbial insecticides offer is their extremely low toxicity to nontarget animals and humans. Dipel 10G and Dipel ES are different formulations of a microbial insecticide that contains spores and the crystalline endotoxin of the bacterium

Bacillus thuringiensis kurstaki (B.t.). Each of these formulations is registered and provides effective control of the European corn borer. B.t. products are effective only against the caterpillar stages of moths and butterflies. Because they have very low toxicity to most other organisms, B.t. products are very useful in the management of the European corn borer in fields where worker safety or the safety of people in residential areas is a prime concern. An example of where the use of B.t. products makes good sense is for seed fields where detasselers are working.

Many nonchemical alternatives in insect management often have been referred to as cultural approaches. These include the use of resistant crop varieties or trap crops, altering planting or harvesting dates, crop rotation, and the use of fly-free dates (listed by county in NHE-152) for seeding wheat to prevent infestations of Hessian flies. By practicing many of these suggested cultural approaches, Illinois farmers are currently reducing the amount of insecticides used to a great extent. By rotating corn with soybeans, producers eliminate the need for a soil insecticide on approximately 6 million acres of Illinois farmland each year. The importance of this nonchemical approach to insect management is often overlooked.

It must be mentioned that after a producer has explored all of the pest management options, the decision not to treat should be recognized as a valid choice. Although economic factors are often the pivotal point on which a grower makes an insect control decision, farmers are becoming increasingly aware of environmental and societal concerns regarding their pest management considerations. Questions such as the following will be asked more frequently in the future: (1) Will this pesticide contaminate groundwater, even when normal labeled recommendations are followed?; (2) Will the use of this pesticide expose me or my family to any serious health and safety risks?; (3) Will the use of this product seriously reduce nontarget populations of other organisms?; and, (4) Will the use of this product at labeled rates show up as an unsafe residue in food products? A producer's decision not to use an insecticide because of his or her response to these or similar questions must be considered a valid one.

Insect Pests of Field and Forage Crops

Corn Insects

Armyworms

Armyworms damaged both corn and wheat during the spring of 1989. The outbreak was probably a result of the drought conditions of 1988 reducing the populations of natural enemies that usually hold armyworms in check. However, toward the end of June 1989, naturally occurring diseases killed many armyworms. Damaging levels of the later generation of armyworms did not materialize.

Armyworms do not overwinter in Illinois. Like the black cutworm, armyworm moths fly or are blown into Illinois on storm fronts early in the spring. The moths seek rank, grassy vegetation on which to deposit their eggs. Wheat and rye provide excellent egg-laying habitats. As a consequence, corn planted no-till into rye or some other grassy cover crop may experience severe damage by armyworm larvae. Cornfields adjacent to wheat fields are also at risk. If the larvae completely defoliate a wheat field or if the wheat field matures, armyworms may assume their gregarious marching habit and crawl into a nearby cornfield.

Upon hatching, armyworm larvae feed on grassy vegetation. However, when herbicides are used to control these grasses in no-till or very weedy cornfields, the larvae will move from the dying grass to feed on corn seedlings, usually chewing along the outer edges of the newly emerged leaves. If the armyworm population is large enough, the larvae may completely strip the corn plants. Corn usually recovers if the plants have not been damaged below the growing point. If the infestation is severe and plants are eaten below the growing point, entire stands of corn can be significantly reduced or even destroyed.

Control of the first generation of armyworms in seedling corn may be justified when 25 percent of the plants are being defoliated. A second generation of armyworms occurs around pollen shed, but control is justified only when the armyworms have devoured all the leaves below the ear and are starting to defoliate the leaves above the ear.

Corn cutworms

The occurrence and extent of cutworm infestations are difficult to predict each year. ***Sandhill, dingy,*** and ***claybacked cutworms*** all overwinter in Illinois as partially grown larvae, but their populations are seldom widespread. As a result, they cause damage early in the growing season in scattered areas. Sandhill cutworms are a problem in sandy areas almost every year. Dingy and claybacked cutworms occur more frequently in corn planted after sod or forage legumes than in other crop rotations.

Black cutworms do not overwinter in Illinois, so outbreaks are difficult to forecast. Infestations of black cutworm larvae arise from eggs laid by moths that fly or are blown into Illinois on storm fronts in the early spring. A statewide program of monitoring black cut-

worm pheromone traps provides information about the time and intensity of spring moth flights.

Certain factors favor black cutworm outbreaks. The most important factors may be late planting and preplant weed infestations. Fields that are tilled and planted late are more likely to develop a preplant weed infestation than fields that are planted early. These late-planted fields with weeds are more attractive to cutworm moths as a site on which to deposit their eggs.

Currently, two options are available for cutworm control: applications of soil insecticides to prevent damage and rescue treatments after the infestation appears. **Because of the uncertainty in predicting which fields will have light, moderate, or heavy infestations of cutworms, it is advisable to use rescue treatments for cutworm outbreaks rather than to use a preplant or planting-time treatment unnecessarily.**

Based on the relatively low incidence of cutworm problems over the past 30 years, a grower should find an economic advantage to the wait-and-see system, which involves field scouting rather than a costly always-apply program in which the soil insecticide is routinely applied at or before planting for a problem that may not exist.

Rescue (or emergency) treatments. The keys to effective cutworm control with rescue treatments are the amount of surface moisture and the movement of the worms. Control may be poor, regardless of the insecticide used, if the topsoil is dry and crusted and the worms are working below the soil surface. When the soil is dry, the higher recommended rates of the insecticides should be considered.

To determine the need for rescue treatments, scout the fields during plant emergence, particularly those fields considered to be high-risk. Early detection of leaf-feeding or of cutting by cutworms is vital. When the corn plants are beginning to emerge, check the fields for leaf-feeding, cutting, wilting, or missing plants. Small cutworm larvae (less than ½ inch) feed on the leaves and do not begin cutting plants until they are about half-grown.

A control measure may be needed on corn if 3 percent or more of the plants are cut and cutworms are still present. A single cutworm will cut 3 or 4 plants if the plants are in the 2-leaf stage or smaller. After corn plants reach the 4-leaf stage, a single cutworm will cut only 1 or 2 plants during the remainder of its larval stage.

Corn leaf aphids

In the drier regions of Illinois in 1989, corn growers found rather large populations of corn leaf aphids. Although populations in individual fields were large, the outbreak was not widespread. However, their presence in moisture-stressed fields during pollination caused some yield reduction in both seed corn and field corn.

Corn leaf aphids do not overwinter in Illinois, relying instead on storm fronts in late June through early July to carry them to their destination. Corn leaf aphids are soft-bodied, have a bluish-green color, and are roughly the size of a pinhead. At the rear of these insects, two projections referred to as cornicles ("tail pipes") can be easily seen with a hand lens.

Aphids have piercing-sucking mouthparts with which they remove fluids from plant tissues. Their feeding injury to corn is most severe when the removal of fluids and sugars occurs during the pollination period and the crop is under moisture stress. In addition, the aphids secrete a sugary "honey dew" which often coats the tassels and interferes with pollen shed.

Corn leaf aphids have tremendous reproductive powers, and populations can seemingly explode in a very short time. Approximately nine generations of these aphids occur per year in Illinois. When aphid numbers begin to increase significantly, clusters will begin to show up on leaves and in the whorls of plants. As these clusters grow larger, winged females will become more numerous. These females fly away from heavily infested plants and move to other plants to begin new colonies.

Control may be warranted when 50 percent of the plants have light to moderate levels of aphids on the tassels and upper leaves, and the corn is suffering from a lack of moisture. Aphids can also lower yields soon after pollination is complete if 20 to 25 percent of the plants are heavily infested (upper leaves and tassel covered) and the corn is under moisture stress. Before a management decision is made, however, the number of predators and percentage of diseased aphids should be determined. Aphidlions and ladybird beetle larvae and adults are excellent predators of aphids. Parasitized aphids are smaller, hardened, brownish, and stuck to leaves or tassels. Diseased aphids are shriveled and moldy.

Corn rootworms

Populations of northern and western corn rootworm beetles were high in many areas of Illinois in 1989. However, environmental conditions and the condition of the corn crop varied significantly across the state, so the numbers of rootworm beetles also varied from region to region. Although the potential for rootworm damage to corn following corn is greatest in the northern two-thirds of the state, moderate to severe damage to corn roots by larvae may occur in any field where corn follows corn in Illinois.

Rootworm life cycle

Western and northern corn rootworm beetles deposit their eggs in the soil at the base of the corn plants or between rows during August and September. The eggs overwinter in the soil and begin hatching in late May. Egg hatch usually takes place over a period of 3 to 5

weeks. Consequently, in July and August all stages of the corn rootworm — egg, larva, pupa, and adult — may be found. The rootworm larvae feed on the roots of corn plants during June, July, and August. When a larva is fully grown (½ inch), it builds a cavity in the soil and goes into the pupal or resting stage. After 5 to 10 days, the beetle emerges from the soil. The development from egg hatch to adult emergence takes 27 to 40 days. After the females emerge from the soil and mate, 14 days or more elapse before they begin laying eggs. Rootworm beetles may deposit as many as 1,000 eggs; an average of 500 per female is probably common. Most egg-laying in Illinois occurs after August 1.

Extended diapause

Since 1986 in the northern half of Illinois, a small number of fields of corn following soybeans have been damaged by corn rootworm larvae. Entomologists have verified that the damage was caused by northern corn rootworms, some of which are known to undergo extended diapause (a period of suspended development) in the egg stage. Extended diapause is not known to occur in the western corn rootworm population, the predominant species of rootworms in Illinois.

Crop rotation and certain environmental conditions may favor the expression of extended diapause in northern corn rootworms, thereby enabling the eggs to survive two winters before hatching. Ordinarily rootworm eggs hatch the year after they are deposited.

Should a farmer use a corn rootworm soil insecticide on corn following soybeans to control corn rootworms in 1990? Although the answer is not a clear-cut "no," the percentage of cornfields following soybeans that have been economically damaged by corn rootworms has been extremely small. Based on a random survey of 990 fields of corn following soybeans in the northern half of Illinois, only 1 percent of the fields sampled from 1986-1989 had economic rootworm damage. At this point there is little justification for using a soil insecticide in corn following soybeans. A few fields may sustain damage in 1990, but it is impossible to predict where these will be.

What scenerio might best describe how corn rootworm damage to corn following soybeans might occur in 1990 as a consequence of extended diapause in the northern corn rootworm population? Northern corn rootworm beetle numbers had to exceed 2 beetles per plant in a field of corn during August 1988 in order to produce a sufficient number of diapausing eggs to cause larval damage to corn after soybeans in 1990. Research entomologists in Illinois are conducting investigations into the phenomenon of extended diapause within the northern corn rootworm populations to determine the extent of this trait in Illinois.

Determining potential for damage in 1990

Corn growers should base the need for using a rootworm soil insecticide in 1990 on the abundance of rootworm beetles in cornfields during late summer of 1989. Generally, if beetle numbers reached or exceeded 0.75 per plant at any time during late July, August, or September 1989, plan to apply a rootworm soil insecticide if the field is to be replanted to corn in 1990.

However, if the field scouted in 1989 was corn following any crop other than corn, the threshold (beetles per plant) is lower. The ratio of female to male beetles in first-year corn is usually higher than in continuous corn. The females apparently migrate into first-year cornfields, so most of the beetles found there are females. As a consequence, the threshold for determining whether to rotate away from corn or to use a soil insecticide in 1990 may be as low as 0.5 beetle per plant. (See "Scouting to Determine Rootworm Potential in 1991" for a discussion about adjusting thresholds for different plant populations.)

Fields of corn planted in late May or June 1989 may have extensive rootworm damage if replanted to corn in 1990. During August and September, rootworm beetles are especially attracted to late-planted or late-maturing fields. Seeking fresh pollen and silks to feed on, the beetles lay millions of eggs in these fields. Planting the fields to a crop other than corn in 1990 is suggested to reduce the rootworm population.

Suggestions for rootworm management, 1990

During the past 12 years, the performance of rootworm soil insecticides has been variable. They have provided effective control at some locations and have been marginal or ineffective at others. An immediate solution to the problem of erratic rootworm soil insecticide performance is not readily available. Perhaps there is none. It is entirely possible that changes brought about by treating millions of acres of corn with soil insecticides over the past 20 years have introduced an era when rootworm control with current soil insecticides will be highly variable.

Looking to 1990, you should seriously consider crop rotation, particularly in fields where there is a high probability of rootworm damage. Other alternatives include applications of a soil insecticide at planting or at cultivation. Planting time treatments of a soil insecticide will be the predominant method of rootworm control. However, a cultivator application in early June near the beginning of rootworm egg hatch can be an effective option. If you use a soil insecticide at planting, plan to check fields in early to mid June to determine whether damage is occurring. If so, a cultivator application may be needed as a rescue treatment.

Crop rotation. Crop rotation is an extremely effective way to prevent damage from northern and western corn

rootworm larvae. If feasible, do not grow corn two years in succession in the same field. First-year corn following soybeans will generally not require a soil insecticide for rootworm control (see "Extended Diapause").

Although rootworm beetles can be found in "clean" or weed-free soybean fields, and may even lay a few eggs there, the number of eggs is not great enough to warrant the use of a soil insecticide on corn the following season. In a few instances, rootworm larval damage has occurred to corn planted after soybeans when the bean field had been heavily infested with volunteer corn or weeds during August of the preceding year. Adult northern and western corn rootworms were attracted to these fields to deposit eggs. As a result, root damage by larvae occurred the following season. Soybean fields that had 5,000 or more volunteer corn plants per acre in 1989 may warrant treatment for rootworm control in 1990 if they are planted to corn. Good weed control in soybeans will usually prevent rootworm damage in corn following soybeans.

Corn rootworm beetles deposit the vast majority of their eggs in cornfields. The larvae cannot survive on the roots of broadleaf crops (soybeans or alfalfa) or broadleaf weeds. Consequently, when a crop other than corn, soybeans for example, is planted in a field with soil containing millions of rootworm eggs, the rootworm larvae die from starvation.

Soil insecticides. *At planting.* Certain granular soil insecticides can be applied at planting time to prevent damage by corn rootworm larvae. The granules should be applied directly over the row in a 7-inch band ahead of the planter press wheel or firming wheel and lightly incorporated with spring tines or drag chains mounted behind the planter units. Some insecticides can also be applied in the seed furrow, but others are not labeled for in-furrow application because they either won't provide adequate root protection or they will cause seedling injury. Consult Tables 4 and 5 for recommended rates of application and proper placement.

Liquid insecticides labeled for rootworm control can be used by growers who do not have granular applicator attachments on their planters. These products are highly toxic, so **use extreme caution when handling liquid insecticide formulations.** Liquid insecticides may be either mixed with water and applied as a spray in a 7-inch band ahead of the press wheels, or they may be mixed with liquid fertilizer and used with a split-boot applicator at planting. However, *incompatibility or crop injury* may be a problem with combinations of a liquid insecticide and a liquid fertilizer. Conduct a test before planting to make certain that the two are physically compatible. Maintain agitation in the tank after mixing and during application to prevent separation. Consult Tables 4 and 5 for recommended rates of application and proper placement.

The rates suggested in Table 4 should not be exceeded for rootworm control. Research has shown that increasing the rates of soil insecticide application does not improve rootworm control. Increasing the rate of the product will not solve rootworm control problems and may even accelerate the onset of resistance in the rootworm population.

Proper calibration, placement, and incorporation of rootworm soil insecticides will improve the likelihood of good control. See the section "Calibration for Granular Soil Insecticides" in this circular.

Soil insecticides will give 50 to 70 percent control of corn rootworm larvae, which is usually adequate to prevent economic levels of larval damage in most fields. But in some heavily infested fields enough larvae may survive to cause economic levels of root damage, and beetle populations may be large enough to interfere with pollination.

Planting-time treatments applied in early April may provide only marginal control. Consider a cultivator application in late May or early June in such fields, rather than a treatment at planting time.

At cultivation. A cultivation-time application of a soil insecticide is an alternative to a planting-time application or may be used as a "rescue" treatment if the planting-time insecticide fails to control rootworm larvae. In either case, you should dig up several plants and examine the roots and surrounding soil for rootworm larvae and damage. If you find 3 or more larvae per plant and the field was not treated at planting, a cultivator application is warranted. If the field was treated at planting and rootworm larvae and damage are obvious in June, plan to apply a cultivator treatment. "Obvious" rootworm damage is characterized by brown root tips and roots that have been tunneled in or chewed back toward the base of the plant.

The insecticide should be applied on both sides of the row at the base of the plants just ahead of the cultivator shovels. Cover the insecticides with soil. The best time to apply a basal treatment of a soil insecticide at cultivation is usually in late May or early June if evidence of rootworm feeding damage is noted.

Soil moisture may affect both application and effectiveness of cultivation-time treatments. Fields that are too wet may never be cultivated. On the other hand, the insecticide may not perform satisfactorily if the soil is too dry.

Suggestions for alternating rootworm soil insecticides. Avoid using the same soil insecticide for several consecutive years or in fields where there have been performance problems. The continuous use of one insecticide may enable soil microorganisms to break it down more rapidly or may hasten the onset of insecticide resistance. **Illinois entomologists encourage growers to consider alternating rootworm soil insecticides, rather than**

using one product for several consecutive years. Consider the following suggestions for alternating rootworm soil insecticides:

1. If performance of a soil insecticide has been poor in a particular field in recent years, do not use the same insecticide in that field in 1990.
2. Avoid using carbamates in consecutive years.
3. Avoid using the same organophosphate or pyrethroid for several consecutive years.

Control of rootworm beetles to prevent egg-laying. Research conducted during the mid 1970s indicated that properly timed sprays to prevent rootworm beetles from laying eggs could eliminate the need for a soil insecticide the following year. However, the procedure is not foolproof. Factors beyond the control of the operator, such as beetle migration and weather, may minimize the treatment's effectiveness.

Growers who have experienced erratic rootworm control with soil insecticides the past few years and who are committed to a continuous corn program may look to beetle control as an alternative, or an addition, to soil insecticides at planting. Ideally, one properly timed spray should *replace* a soil insecticide. Unfortunately, some fields will require two sprays to combat extended beetle emergence and egg-laying. Two sprays or a spray plus a soil insecticide the following season may hasten the onset of rootworm resistance to insecticides.

It is important to recognize that control programs to prevent egg-laying and controlling beetles to prevent silk clipping do not overlap in time. Most eggs are laid from mid-August through early September, well after the time when treatments to prevent silk clipping would be necessary.

The prerequisites for a successful beetle suppression program are very complex. One must be able to identify both species (western and northern), to distinguish between the sexes, and to determine whether the females are gravid (eggs present). Frequent scouting trips and precise techniques are also requirements. A rootworm beetle suppression program should be employed only if the fields are under the supervision of properly trained pest management personnel. For more specific information about this rootworm management alternative, contact the Extension entomologists at the University of Illinois.

Summary: Planning your rootworm management program. A management plan for rootworms should be long range (not a year at a time) and include crop rotation, insecticide rotation, cultivator treatments, and scouting to determine the need for rootworm control.

1. Alternate corn with another crop when possible, particularly in fields where rootworm beetles averaged 0.75 or more per plant last summer, or if the soil insecticide did not give effective rootworm control in 1989.
2. If you intend to grow corn after corn and if rootworm beetles averaged 0.75 or more per plant in corn after corn or 0.5 beetle per plant in first-year corn last summer, apply a rootworm soil insecticide at planting time. Apply the rate suggested in Table 4 and consider our suggestions for alternating rootworm soil insecticides.
3. Consider a cultivation-time application of a rootworm soil insecticide if you intend to plant in early April or if your planting-time insecticide does not provide effective control.
4. Scout for rootworm beetles in July and August 1990 to determine the potential for rootworm larval damage in 1991.

Scouting to determine rootworm potential in 1991

The abundance of rootworm beetles in a cornfield in July and August is an indicator of potential rootworm problems the following year. You can determine the potential for rootworm damage in 1991 by counting western and northern corn rootworm beetles from mid-July through August, 1990, in this way:

1. Scout fields at least three times at 7- to 10-day intervals between mid-July and late August in fields to be replanted to corn.
2. Examine 5 plants selected at random in each of 10 areas of the field. Count all of the western and northern corn rootworm beetles on 50 plants each time. The counts take about 45 minutes in a 40-acre field.
3. As you approach a plant, move quietly to avoid disturbing the beetles. Count the beetles on the entire plant, including the ear tip, tassel, leaf surface, and behind the leaf axils.
4. Record the number of beetles you find per plant. If the average is more than 0.75 beetle per plant in corn after corn or 0.5 beetle per plant in first-year corn for any sampling date, plan to rotate away from corn or apply a rootworm soil insecticide to corn in 1991. If populations do not exceed an average of 0.5 beetle per plant for any sampling date, a soil insecticide will not

Table 1. Thresholds for Corn Rootworm Beetles (Average Number of Beetles per Plant) for Different Plant Populations and Cropping Sequences

Average number of plants per acre	Average number of beetles per plant	
	Continuous corn	First-year corn
14,000	1.4	1.0
16,000	1.3	0.9
18,000	1.1	0.8
20,000	1.0	0.7
22,000	0.9	0.6
24,000	0.8	0.6
26,000	0.8	0.5
28,000	0.7	0.5

be needed the following season.

Entomologists at Purdue University incorporate corn plant populations as well as cropping sequence into their decision-making procedures. Plant population affects thresholds simply as it relates to the number of beetles per acre. Table 1 shows the thresholds for different plant populations and cropping sequences. If the beetle count exceeds these thresholds, management of next year's larval population through crop rotation or insecticide application (corn following corn) is recommended.

European corn borers

European corn borer populations were very high in 1989 in some areas of Illinois. Very large first- and second-generation moth flights were observed in west central, north central, and northwestern counties of Illinois. Many producers in these areas treated for first-generation corn borers but neglected to scout and evaluate the damage potential of the second generation. Results of the 1989 fall survey indicated that many fields had large populations of corn borers and a high incidence of stalk breakage. Because of heavy feeding damage by second-generation borers, the potential for direct yield losses (dropped ears) was very high in 1989, especially for those producers who delayed harvest in seriously infested fields.

Overwintering populations (1989-90) of the European corn borer were much greater than they were in 1988-89. A mild winter with abundant snowfall will increase the survivorship of European corn borer larvae. The first flight of moths in 1990 is expected to be large; however, if spring conditions are characterized by stormy and cool weather, success of mating and egg-laying will be reduced.

The European corn borer (ECB) usually has two generations a year in Illinois. In some years there may also be a partial third generation in southern and central Illinois. There are four stages in each generation: egg, larva, pupa, and adult (moth). The ECB overwinters as a full-grown larva in corn stalks, cobs, and plant residue.

First generation

The ECB moths that lay eggs for the first generation begin to emerge in late May in southern Illinois and in mid-June to late June in the central and northern regions. The females lay most of their eggs in the evening and spend the daylight hours in fencerows and other protected areas (action sites).

First generation ECB larvae reduce yields by stalk-tunneling, which weakens the plant and destroys the tissue used to transport food within the plant.

Different corn hybrids have variable degrees of tolerance or resistance to leaf-feeding by first-generation borers. Consider this trait when selecting varieties.

Scouting procedure. Corn that is planted early (the fields with the tallest corn) should be monitored closely from mid-June to early July for signs of whorl-feeding by corn borer larvae. The fields with the tallest corn in mid-June are the most attractive to moths laying eggs for the first generation.

Plan to scout cornfields for damage at least once a week for a 2- to 4-week period following peak corn borer moth flight, generally from early June to early July.

To determine the need to treat, examine 100 plants (20 consecutive plants at 5 different locations in a field) for shot-hole feeding in the whorl leaves. Unroll the whorl leaves of 10 infested plants (those with shot-hole feeding) and count the *live* corn borers per infested plant. Calculate the percentage of plants infested and the average number of live borers per infested plant. Also note the location of the corn borer larvae. Those that are still in the whorl leaves can be controlled, while those that have bored into the stalk are protected from the insecticide. If all larvae have left the whorl leaves and bored into the stalk, it is too late to apply a treatment.

Treatment guidelines. To decide whether it will be profitable to treat a field infested with first-generation corn borers, the following information is needed:

1. Average percentage of plants with whorl feeding.
2. Average number of larvae per infested plant.
3. Expected yield per acre.
4. Value of grain per bushel.
5. Cost per acre for insecticide treatment.

Enter these data into the worksheet below to calculate the gain or loss for applying an insecticide to control corn borers.

Second generation

European corn borer moths laying eggs for the second generation are attracted to fields of corn that have recently tasseled or are in the pollen shedding or green silk stage. Late-planted fields of full-season hybrids are usually more attractive and are more likely to sustain economic damage.

Yield losses caused by second-generation ECB are primarily the result of physiological injury, although stalk breakage and ear droppage may become significant if harvest is delayed. Stalk tunneling by corn borers also increases the likelihood of stalk rot.

Scouting procedure. To assess the need for controlling second-generation ECB, start checking for egg masses when moth flight is under way, usually around mid-July in southern Illinois and late July to mid-August in central and northern Illinois. Concentrate initial scouting efforts in late-planted fields where the probability of an economic ECB infestation is greatest.

Examine a minimum of 25 plants, selected at random throughout the field, and count the number of ECB egg masses that are found on each plant. European corn

Management Worksheet for First-Generation Corn Borer

______ % of 100 Plants Infested × ______ Average No. Borers/Infested Plant = ______ Borers/Plant
(determined by checking whorls from 10 plants)

______ Borers/Plant × 5% Yield Loss/Borer = ______ % Yield Loss

______ % Yield Loss × ______ Expected Yield (Bu/A) = ______ Bu/A Loss

______ Bu/A Loss × $__________ Price/Bu = $__________ Loss/A

$__________ Loss/A × ______ % Control = $__________ Preventable Loss/A
(80% for granules)
(50% for sprays)

$__________ Preventable Loss/A − $__________ Cost of Control/A =
$__________ Gain (+) or Loss (−) per acre if treatment is applied

Management Worksheet for Second-Generation Corn Borer

______ Number of Egg Masses/Plant × 2 Borers/Egg Mass*.= ______ Borers/Plant
(cumulative counts, taken 7 days apart)

______ Borers/Plant × __4__ % Loss/Borer** = ______ % Yield Loss

______ % Yield Loss × ______ Expected Yield = ______ Bu/A Loss

______ Bu/A Loss × $__________ Price/Bu = $__________ Loss/A

$__________ Loss/Acre × __75__ % Control = $__________ Preventable Loss/A

$__________ Preventable Loss/A − $__________ Cost of Control/A =
$__________ Gain (+) or Loss (−) per acre if treatment is applied

* Assumes survival rate of 2 borers/egg mass.
** Use 3% per borer per plant if infestation occurs after silks are brown. The potential economic benefits of treatment decline rapidly if infestations occur after corn reaches the blister stage.

borer moths usually lay their eggs on the underside of the two or three leaves above or below the developing ear. However, you should check all leaves on the plant for egg masses. One technique is to remove the leaves one by one, starting at the bottom of the plant, and carefully scan them for egg masses. The eggs, which are deposited in masses of 15 to 30, overlap like the scales of a fish.

Egg masses are flat and about ¼ inch in diameter. Newly deposited eggs are white, then turn pale yellow, and become darker just before hatching. Eggs that are about to hatch have distinct black centers. These are the black heads of the larvae that are visible through the translucent eggshell. The eggs hatch in 3 to 7 days, depending on the temperature.

The female moth rests in grassy areas during the day. Noncrop areas that border cornfields may harbor large numbers of corn borer moths. Check these areas for moths as you enter the field to determine the potential for corn borer infestation.

Calm nights favor egg deposition by the moths. The absence of hard, beating rains during moth emergence also increases the potential for infestations.

Treatment guidelines. To determine whether it will be profitable to treat a field to control second-generation corn borers, the following information is needed:

1. Average number of ECB egg masses per plant.
2. Crop maturity.
3. Expected yield per acre.
4. Value of corn per bushel.
5. Cost per acre for insecticide treatment.

For best results, treatment should be applied soon after egg hatch to kill the young larvae before they bore into the plant. The larvae begin tunneling into the stalks about 10 days after hatching. Occasionally, two treatments may be necessary for satisfactory control if egg laying extends over a 3- to 4-week period.

Grape colaspis

The grape colaspis overwinters as a small larva in the soil. In early spring, the larvae move toward the soil surface and feed on corn and soybean roots. They complete their larval development in mid-June to early July and then enter the pupal, or resting, stage. Adults emerge from the soil in late July and can be found during August in clover, alfalfa, soybeans, corn, and patches of smartweed. The eggs hatch in early fall.

The grape colaspis larva is about ⅛ to ⅙ inch long when fully grown and is shaped like a comma. It has a rather fat, white body and a yellow-brown head. The adult is a yellowish brown, elliptical beetle that resembles a northern corn rootworm. Unlike the northern corn rootworm, the wing covers of the grape colaspis are marked with longitudinal rows of ridges with evenly spaced punctures.

Grape colaspis larvae feed on the roots and root hairs of both corn and soybeans, preventing the plants from getting enough moisture and nutrients. They also scarify the roots and eat out narrow strips on the root. The first symptom of colaspis damage to corn is purpling and wilting of the leaves. Damaged soybean plants are wilted. If the infestation is severe enough, the leaves turn brown and die, and plant populations are reduced. Rapidly growing, healthy corn and soybean plants often do not show symptoms of feeding damage due to grape colaspis.

Because colaspis beetles lay their eggs in red clover and soybeans, the potential for damage is greatest in fields of soybeans and corn planted after soybeans or red clover. However, if growing conditions are ideal during the spring, grape colaspis probably will not be a prevalent problem.

The use of a soil insecticide to prevent damage from grape colaspis is not warranted. In fact, none of the currently available soil insecticides is labeled for control of grape colaspis in either corn or soybeans.

In addition, there are no effective rescue treatments for grape colaspis after the damage appears. If plants show symptoms of injury, dig around the root system of several plants. If grape colaspis larvae are causing the problem and replanting is warranted, consider applying an insecticide that is labeled for control of white grubs.

Stalk borers

Fields that are to be planted to corn in 1990 and were infested with living quackgrass, giant foxtail, ragweed, or wirestem muhly during August or September 1989 should be monitored carefully for stalk borer damage in the spring. Stalk borer moths deposit their eggs on leaves and stems of grasses during the later months of the summer. Eggs overwinter and hatch in late April to early June. Larvae can be identified easily by the prominent white and purple longitudinal stripes running the length of their bodies; the stripes are interrupted about midway by a dark purple band. After egg hatch, young stalk borers begin an active search for a host plant stem into which they will burrow. As the larvae mature and increase in size, they leave their weed host to seek a larger plant.

Young stalk borer larvae infest small corn plants either by burrowing directly into the stem or by crawling down into the whorl and then burrowing in the stem. Upper leaves are often cut off from within the plant, and they wilt and die quickly. Outer leaves may remain green and appear normal. Larvae may also feed directly on growing point tissue in young plants, causing stunting or death of plants. The symptom for this type of injury is referred to as "dead heart." Plants that are infested but are not killed often remain barren.

Corn plants adjacent to fencerows, grass conservation lanes, or grassy terraces where stalk borers laid eggs the previous summer are most likely to be infested by larvae in the spring. If grass control the previous season was poor throughout the field, an infestation of stalk borers can be widespread. In addition, corn planted no-till into grassy vegetation is a good candidate for stalk borer injury.

Rescue treatments are not effective after the stalk borers have tunneled into the corn plants. Ideally, post-emergence sprays should be applied when larvae are moving from their initial weed hosts to young corn plants, but timing this event is very difficult. Often by the time stalk borer damage is noticed, it is too late to do anything except consider replanting the infested area of the field. If replanting is warranted and damaged plants won't be disked under, an insecticide should be applied as soon as plants begin to spike. This treatment should prevent larvae from infesting the most recently planted corn. One of the best methods of reducing the

potential for stalk borer damage is a good weed control program that eliminates suitable egg-laying sites (grassy weeds) within a field.

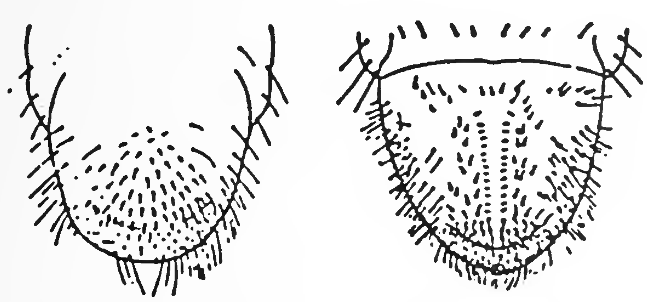
White grubs

Several species of economically important white grubs have three-year life cycles. Peak years of damage usually occur during the year following large flights of May beetles, the adult stage of white grubs. The beetles prefer to lay their eggs in ground covered with vegetation, such as weedy soybean fields and sod.

The C-shaped white grub larvae chew on the roots and root hairs of corn seedlings. During peak years of damage, the grubs feed all season long. Damage to a cornfield is most apparent in the spring. Symptoms of white grub injury visible aboveground are irregular emergence, reduced stands, and stunted or wilted plants. The damage is usually spotty throughout the field.

There are no effective rescue treatments for white grubs after the damage appears. However, if plants show symptoms of injury, dig around the root system of several corn plants. If white grubs are causing the problem and replanting is warranted, use a labeled soil insecticide.

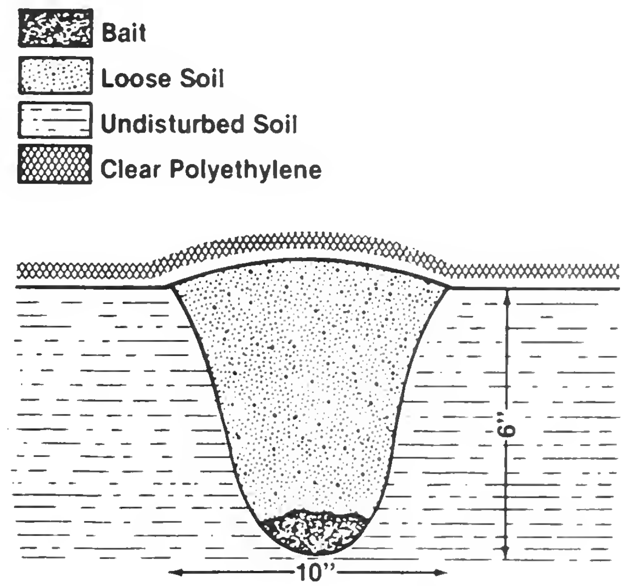
One way to detect the presence of white grubs is to look for them during spring tillage operations. However, if you turn up grubs during spring tillage, be sure to identify them correctly by examining the pattern of hairs on the underside of the last abdominal segment (see diagram). True white grubs (right), the species that may damage corn, have two parallel rows of hairs on the underside of the abdomen. Annual white grubs (left) have a more random pattern of hairs, and they rarely cause economic damage to corn. The presence of true white grubs during spring tillage operations might warrant application of a soil insecticide.



Last Abdominal Segment of Annual and True White Grubs

Wireworms

During the past five years wireworm damage to corn has occurred with increasing frequency. Even so the



Cross Section of a Wireworm Solar Bait Station

proportion of fields of corn affected by wireworms in Illinois is small (less than 1 percent) and does not justify the widespread use of a soil insecticide on first-year corn after soybeans. A lindane or diazinon + lindane planter-box seed treatment may help deter the wireworms from attacking the seed but will not protect the seedling.

Wireworms may attack the seed or drill into the base of the stem below ground level, damaging or killing the growing point. Damage will show up as wilted, dead, or weakened plants and spotty stands. Wireworm larvae are reddish- or yellowish-brown and wirelike; several species are known to attack corn. They live for two to five years in a field in the larval stage, feeding on the roots of grasses and crops. Their presence is often related to the crops or weeds that were in the field two to four years before damage to the corn is apparent. Most reports of damage to corn have been in fields where corn follows soybeans or where there has been a corn-soybean-small grain rotation. The adult (a click beetle) prefers to deposit its eggs in small-grain stubble or in grassy fields.

Wireworms are usually most damaging in bottomlands or in poorly drained areas on upland soils. Low spots in the field often have the heaviest populations.

Attempts to control wireworms with an insecticide rescue treatment after the damage appears are not very successful. Therefore, if an infestation is known to be present, an insecticide should be applied at planting.

Checking for wireworms

A technique using baits has been developed for evaluating wireworm potential before planting. The bait stations should be established 2 to 3 weeks before the

anticipated planting date. Fields where small grain or grasses have been grown the preceding 2 or 3 years are the best candidates for bait stations.

Since wireworm infestations are usually not uniform within a field, it will be necessary to place the bait stations randomly throughout the field. One bait station per acre is desirable. If you cannot place one bait station per acre, be sure that your baiting program adequately represents all different areas of the field.

Follow this procedure for baiting:

1. Use a mixture of 1 cup of untreated wheat and 1 cup of untreated shelled corn at each station.
2. Bury the bait about 4 inches deep. It is also desirable to cover the ground over each bait station with an 18-inch square of clear plastic (see diagram). The plastic collects solar heat and speeds germination of the corn and wheat, which attracts overwintering wireworms.
3. Mark each station with a flag or stake.
4. Dig up the bait stations in 10 to 14 days and count the number of wireworms.

Need for treatment

If you find an average of one or more wireworms per bait station, use a labeled soil insecticide. In some instances, several wireworms may be found in one bait station and none in others. Wireworm infestations tend to concentrate in some locations. It may be possible to limit treatment to areas where the concentration of wireworms is heaviest.

Soybean Insects

Bean leaf beetles

Bean leaf beetle populations in soybeans were much lower in 1989 than in 1988. Producers were told well in advance to scout their seedling soybeans for bean leaf beetles because of the large overwintering population (1988-1989); however, very few soybean fields were seriously damaged. If survival of overwintering beetles during the mild winter of 1988-1989 was very good, as we believe it was, why then were so few fields affected by bean leaf beetles in 1989?

After the adults left their overwintering sites (residue in fencerows, wooded areas, and other protected sites), they flew into alfalfa fields and remained there until soybeans emerged. We believe that many bean leaf beetles were killed in alfalfa fields that were treated for alfalfa weevils. Alfalfa weevil populations were extremely high in 1989 and a large percentage of the alfalfa acreage was treated. Bean leaf beetle populations remained low throughout the early portion of the growing season.

Although pod feeding by the second generation was not unusually heavy in all areas of the state, populations of bean leaf beetles late in the season seemed to be reasonably large. As a consequence, producers should be alerted to the potential for seedling injury to soybean fields next spring, especially if the winter is mild.

As temperatures warm above 55°F, the bean leaf beetles fly to alfalfa, clover, or seeds to feed. If soybeans are planted early in 1990, however, the beetles will abandon the forage fields or move directly from hibernation sites to colonize and feed on the leaves of the early emerging bean seedlings. Soybeans can withstand considerable leaf feeding during the vegetative (prebloom) stage, but treatment may be necessary if defoliation reaches 30 percent and at least one cotyledon per foot of row is destroyed.

In addition to feeding on the leaves, the adults lay eggs in the soil near the soybean plant. Egg hatch commences in late May, and the larvae feed on the roots and nodules of the soybeans during June. Adults of the first generation emerge in July. These beetles feed on the soybean foliage, lay eggs, and the new larvae emerge as second-generation adults during August and September. These adults do not lay eggs, although they stay in soybean fields as long as there are green leaves or tender pods to chew on. As soybeans mature, and temperatures fall, the beetles fly to winter hibernation sites.

The availability of early emerging soybeans is essential for the survival of bean leaf beetles coming out of winter hibernation sites. A large acreage of early planted soybeans generally results in the survival of large numbers of bean leaf beetles early in the season and even larger adult populations in August. Conversely, a severe winter and later-planted soybeans will reduce the rate of survival of bean leaf beetles in the spring and also the size of first- and second-generation populations.

Insecticide treatments are recommended during the critical pod-set and pod-fill stages when defoliation exceeds 20 percent. The greatest concern, however, is caused by the beetles' feeding on pods, which leaves scars on many pods. These scars predispose the pods to fungal infections. Beans within the damaged pod may be discolored, deformed, or moldy. A treatment is recommended when 5 to 10 percent of the pods are damaged.

Grasshoppers

Grasshopper populations were highest in west central and northwestern Illinois during 1989, both areas that were hit hard by the drought in 1988 and experienced hot, dry weather again in 1989. Outbreaks of grasshoppers frequently occur in years following a drought because naturally occurring fungal and bacterial diseases do not thrive under hot, dry conditions. These diseases usually suppress grasshopper populations only during periods of warm, humid weather. We do not anticipate

a widespread problem with grasshoppers during the 1990 growing season, but growers in areas afflicted by drought in 1989 should maintain a close vigil in the spring.

Several species of grasshoppers have the potential to damage soybeans by feeding on leaves or pods, but redlegged and differential grasshoppers are the species most commonly found. Eggs are glued together and deposited in the soil in batches during late summer and fall until the first frost. The eggs overwinter and hatch the following spring. Tillage operations to cropland have very little effect on species such as the differential grasshopper because their egg masses are deposited in uncultivated areas like roadsides, fencerows, and field edges. The redlegged grasshopper tends to lay eggs in field margins, roadsides, pastures, meadows, and forage crops.

Grasshopper nymphs can be found feeding in noncrop areas for roughly 40 to 60 days during the spring. This is an important management consideration because grasshopper populations are most easily managed when the grasshoppers are in the nymphal stage. Nymphs are less mobile than adult grasshoppers because they lack functional wings, and their thin cuticle (skin) makes them easier to kill with insecticides. As vegetation in ditch banks and fencerows is mowed or dries out, nymphs begin to move into adjacent rows of soybeans. If nymphal populations average 15 to 20 per square yard in noncrop areas bordering a soybean field, an insecticide labeled for use in these sites should be considered.

After grasshoppers move into soybean fields, the economic thresholds are based upon percentage defoliation or degree of pod injury. An insecticide application may be warranted when defoliation reaches 30 percent prior to the bloom stage or 20 percent between bloom and pod fill. Grasshoppers can also cause direct yield losses by feeding on the pods. Unlike bean leaf beetles that feed primarily on the outer surface of the pod, grasshoppers chew directly through the pod and feed on developing seeds. If 5 to 10 percent of the pods have been fed upon and grasshoppers are actively feeding, an insecticide treatment may be justified.

Stink bugs

Brown and green stink bugs have the potential each year in Illinois to damage developing soybean seeds. These two species of insects have piercing and sucking mouthparts with which they penetrate pods and puncture seeds. Immature stink bugs (nymphs), as well as adults, feed on plant juices, but only the older nymphs and the adults feed on seeds within the pods.

Adult stink bugs are large (5/8 inch long), "shield-shaped" insects. The nymphs usually shed their skins four times (requires approximately 45 days) before reaching the adult stage. Nymphs can be recognized easily because of their bold arrangement of colors consisting of black, green, yellow, and red striped zones.

Stink bugs overwinter in wooded areas or other protected sites away from fields. During the early summer months after they emerge, stink bug adults feed on berries in trees. Soybean fields are not invaded until pods are beginning to set in August. Only one generation of stink bugs occurs each year in soybean fields.

Yield losses may occur due to a combination of factors: direct loss of plant juices, injection of digestive enzymes, and the entrance of diseases through the wound site. Young seeds that are injured usually abort, and more mature seeds may be discolored or malformed. If a bug punctures the embryo, the seed will not germinate. Stink bugs are also capable of transmitting yeast spot disease. In addition to direct yield losses, seed quality may be reduced due to a reduction in oil content which causes greater deterioration during storage.

Soybean fields should be monitored for stink bugs even after the leaves begin to turn yellow and drop from plants. Stink bugs are late-season pests that remain in the fields well into September. Because stink bugs damage the seeds directly, 1 adult or large nymph per foot of row found during the pod fill stage is the recommended economic threshold.

Twospotted spider mites

Many soybean producers were wary of spider mites during 1989 because of their experience with the outbreak in 1988. However, because rainfall was generally more abundant and relative humidities were much higher in 1989 than in 1988, populations of twospotted spider mites remained at noneconomic levels on soybeans throughout most of Illinois. Unfortunately, some areas repeatedly missed rain showers, and populations of spider mites began to build. Some injured soybeans were treated for spider mites in 1989, but some of these fields were later diagnosed as fields in which herbicides had carried over.

Mites are not insects but are closely related arthropods. Mites hatch from very small eggs, which with the aid of a magnifying glass can be seen on the undersurface of soybean leaves. Larvae with six legs emerge from the eggs and progress through two nymphal stages, each with eight legs. Following the last nymphal molt, the eight-legged adults emerge, representing the reproductive stage of the life cycle. The time necessary to complete a generation ranges from 1 to 3 weeks and depends on environmental conditions, primarily temperature.

Mites have piercing and sucking mouthparts with which they puncture plant cells and remove plant juices. Once plant cells have been damaged, they do not recover. Foliage that has yellow and brown stippling and webbing on the undersurface of the leaves is characteristic of

mite damage. Severe infestations may cause complete defoliation of soybean plants. Mites can move very easily throughout fields by ballooning, that is, by spinning webs and moving to a position on a leaf from which they can be blown aloft. Mites can also go from row to row by bridging (moving across leaves in contact) when canopy closure is near completion. Border rows are frequently the first areas of a field that are infested as mites move from nearby grasses and weeds in ditch banks.

If temperatures are moderate and precipitation is near normal during the 1990 growing season, spider mites should not be a problem. The economic threshold for twospotted spider mites is not clearly defined. When mites and symptoms of their feeding damage are obvious, a treatment may be justified. Confining the insecticide application to border rows and other areas of confirmed infestation continues to be the recommended management strategy when mites and damage are found.

Alfalfa Insects

Alfalfa weevils

Alfalfa weevils caused serious damage to alfalfa in 1989. Overwintering populations during 1988-1989 were large, and warm spells during the winter allowed alfalfa weevil adults to lay even more eggs. The early onset of spring brought on the early appearance of alfalfa weevil larvae and subsequent severe defoliation in southern Illinois. Some fields had to be sprayed more than once to prevent significant economic yield loss.

In northern Illinois, alfalfa weevils usually do not lay eggs in the fall. However, it has been speculated that some fall and winter egg-laying occurred, so large populations of alfalfa weevils severely damaged the first spring crop. In addition, many weevil larvae survived the first cutting and continued to damage the regrowth of the second crop. It was reported that some fields were so badly damaged that plants were killed and the stands were reduced.

Alfalfa weevil larvae go through four larval instars, but most of the damage is caused by the last instar. Early instar larvae are yellowish in color and are usually found in the folded terminal leaves. Older larvae are bright green with a black head and a white stripe along the center of the back. After they have completed their development, fully grown larvae spin netlike cocoons on the leaves or in the debris on the ground. Transformation from larva to adult takes place within the cocoon. Adult alfalfa weevils are light brown with a darker brown band along the center of the back. They have a characteristic snout which bears chewing mouthparts.

Numbers of alfalfa weevils are regulated to a large extent by winter weather. During a cold, open winter the mortality rate is high in overwintering weevil populations; during mild winters the mortality rate is low.

A parasitic wasp and a fungal disease may regulate weevil numbers in the spring. Although the wasp and the fungus will be present in alfalfa fields in 1990, we cannot yet predict their effect on weevil numbers. In general, wet weather promotes the spread of the fungal disease throughout the weevil population.

Alfalfa growers in southern and central Illinois should inspect their fields closely in April, May, and June. Early larval damage appears as pinholes in the growing terminals. As the larvae grow, they skeletonize the leaves, and damaged fields appear tattered. Growers in northern Illinois should look carefully for larval damage in May and June. Follow the suggestions in Circular 1136, *Alfalfa Weevil Pest Management Program,* to determine the need and proper timing of a treatment. If this circular is unavailable, a rule of thumb is to treat when 25 to 40 percent of the tips are being skeletonized, depending on the height of the crop.

All growers should examine the stubble after the first cutting of alfalfa has been removed. Surviving larvae and newly emerged adults will feed on the crown and stem buds and either delay or prevent regrowth. Control may be warranted after a cutting when larvae and adults are feeding on more than 50 percent of the crowns and regrowth is prevented for 3 to 6 days.

Potato leafhoppers

Potato leafhoppers also caused significant damage to alfalfa fields in Illinois in 1989. Leafhoppers do not survive the winter in the Midwest; they migrate from the Gulf states into Illinois during May and June. The numerous storm fronts that passed through Illinois in 1989 brought large numbers of leafhoppers into the state. After the leafhoppers arrived, environmental conditions were very good for their survival and development, so large populations occurred in many fields.

The adult potato leafhopper is a tiny, yellowish-green to lime green, wedge-shaped insect about ⅛ inch long. The nymphs resemble the adults in overall body shape, but they are wingless and usually have a more pronounced yellowish coloring. Both life stages are very active insects; the adults jump or fly when disturbed, and the nymphs characteristically move sideways.

Female potato leafhoppers insert their eggs into the stems and large leaf veins of alfalfa plants. The eggs hatch in 6 to 9 days, depending on the temperature. The leafhoppers go through five nymphal instars in about 2 weeks before becoming adults. Because the life cycle is short and females lay eggs for 6 to 8 weeks, generations overlap throughout the season.

Potato leafhoppers may cause moderate to severe damage to the second and third cuttings of alfalfa in all areas of Illinois. Damage first appears as a yellow, wedge-

shaped area at the tip of the leaf. Many people confuse the damage with diseases or nutrient deficiency. Injury caused by potato leafhoppers can reduce both the yield and nutritional quality of the hay, and the effects of damage to one cutting can carry over to the next cutting or even into the next growing season. As a consequence, early detection of leafhoppers with a sweep net is extremely important.

Damage may begin on the new growth as soon as the first hay crop is removed. Stunting and yellowing are signs of leafhopper injury. A swarm of leafhoppers at the time of the first cutting also indicates that there may be a problem in the new growth. The economic threshold for leafhoppers varies with the height of the alfalfa (see Table 2). A treatment is justified when the number of leafhoppers exceeds the economic threshold.

Table 2. Economic Thresholds for Potato Leafhoppers on Alfalfa

Alfalfa height (inches)	Average number of leafhoppers per sweep of sweep net
0-3	0.2
3-6	0.5
6-12	1.0
12 or taller	1.5

Wheat Insects

Aphids

Several species of aphids can be found in wheat fields: English grain aphid, oat bird-cherry aphid, yellow sugarcane aphid, and greenbug. Of this group, only the greenbug is a potential threat to wheat in Illinois. Typically many beneficial insects naturally reduce aphid populations. Some of the common predators and parasites are ladybird beetle adults and larvae, syrphid fly larvae, lacewing adults and larvae, and tiny parasitic wasps.

Correct identification of an aphid species is important in assessing its potential impact on wheat yields. The greenbug, currently the only potentially threatening species, is bright green with a dark green stripe down the middle of the back. The tips of the cornicles ("tail pipes") that extend from the top rear portion of the abdomen are black or darkened. The oat bird-cherry aphid is olive green with a reddish-orange band on the rear of the abdomen. The tips of the cornicles are black. The English grain aphid is bright green and has long, narrow cornicles that are entirely black. The yellow sugarcane aphid is bright lemon yellow and has very short cornicles and conspicuous hairs.

The Russian wheat aphid, a species not yet found in Illinios, is pale green, has extremely short cornicles, and has a "double-tailed" appearance when viewed from the side. This insect has caused severe injury to wheat in the Great Plains states, so entomologists throughout the country are monitoring its progress to the east.

Armyworms

Armyworms damaged both corn and wheat during the spring of 1989. The outbreak was probably a result of the drought conditions of 1988 reducing the populations of natural enemies that usually hold armyworms in check. However, toward the end of June 1989, naturally occurring diseases killed many armyworms, so damaging levels of the later generation of armyworms did not materialize.

Armyworms do not overwinter in Illinois. Like the black cutworm, armyworm moths fly or are blown into Illinois on storm fronts early in the spring. The moths seek rank, grassy vegetation on which to deposit their eggs, and wheat fields are favored egg-laying sites.

The armyworm has six larval instars and requires about 3 to 4 weeks to complete larval development. The last (sixth) instar feeds for about 7 days and consumes more than 80 percent of all foliage eaten during the entire larval period. Smaller larvae often go unnoticed, so the damage seems to appear very suddenly. Large populations of fully grown armyworms can strip a field in a couple of days. If they completely defoliate a field, they may feed on awns and tender kernels and cut through the stem just below the head.

Economic damage to wheat occurs when armyworms consume the flag leaves, clip off heads, and chew on kernels. Control is probably warranted when there are six or more nonparasitized armyworms (¾ to 1¼ inch long) per linear foot of row and before extensive head cutting occurs. Also consider the ratio of fully grown to partially grown larvae and the presence of larvae infected with disease when you make a control decision. When most or all of the worms are full grown, the damage level has probably peaked and pupation will begin soon. Also, if a significant percentage of the larvae are diseased or parasitized, chemical control may not be necessary.

Cereal leaf beetles

The cereal leaf beetle has caused injury to wheat in southern and central Illinois for the past 2 years. The mild winters and lush fall growth have provided excellent overwintering conditions for the beetles.

The cereal leaf beetle adult is a hard-shelled beetle about 3/16 inch long. Its wing covers and head are metallic bluish-black, while its legs and the front segment of its thorax (just behind the head) are reddish-orange. The larva is slightly longer than the adult and resembles a slug. Its skin is yellow to yellowish-brown, but the larva

carries a moist glob of fecal material on its back that gives it a black appearance.

The adults overwinter in clusters in sheltered areas such as ground debris. In the spring, the beetles fly to fields of winter wheat and other small grains. When spring oats emerge, the beetles will quickly infest the young plants. They feed for about 2 weeks before they lay eggs. Eggs usually hatch in 5 days, and the larvae usually take 10 days to become full grown. After the larvae finish feeding, they descend to the ground and pupate in the soil. After 2 to 3 weeks, new beetles emerge. These beetles often fly to the edges of cornfields and feed on the leaves. After feeding for about 2 weeks, the beetles go into summer hibernation.

The larvae eat only the outer surface of the leaves, so damaged plants are silvery in appearance. Severely damaged fields appear frosted. Yield losses occur when the larvae concentrate their feeding on the flag leaves. Control may be warranted when there is an average of one or more larvae per stem. Adults eat longitudinal slits between the veins and completely through the leaves of both wheat and corn. Corn plants usually recover from this injury.

Insecticides for Insect Management

The insecticides suggested for use in this circular are based on registrations granted by the U.S. Environmental Protection Agency (EPA). Not all insecticides registered for control of crop insect pests are included. Effective insecticides that do not present an undue hazard to the user or the environment are suggested whenever possible.

At the time this publication was in preparation, only currently registered insecticides were included. New registrations and changes in registration, labels, and recommendations will be announced through appropriate media sources and county Extension advisers.

The insecticide recommendations in this circular are provided for educational purposes only. Trade names of insecticides have been used for clarity, but reference to trade names does not imply endorsement by the University of Illinois; discrimination is not intended against any product. The reader is urged to exercise the usual caution in making purchases or evaluating product information. **Always consult the insecticide label for specific instructions, application rates, and precautions before applying an insecticide.**

Insecticide Nomenclature

The chemical names used in this circular may be unfamiliar to you. These names are the common, coined chemical names and as such are not capitalized (e.g., terbufos). Trade names are capitalized (e.g., Counter). In the tables of suggestions for control, only the trade name is listed. In the table of limitations (Table 12), the trade names are listed first, with the common names in parentheses following the trade names.

Federal and State Laws

The U.S. EPA classifies pesticides for ***general*** or ***restricted*** use (Table 3).

Commercial applicators who apply restricted-use pesticides must be certified. Commercial applicators include persons applying a pesticide for hire and governmental personnel, chemical company representatives, and others involved in demonstrational, regulatory, and public health pest control. Certification as a commercial applicator requires passing written examinations administered either by the Illinois Department of Agriculture or the Department of Public Health.

Private applicators (farmers) who use restricted-use pesticides for the purpose of producing any agricultural

Table 3. Insecticide Classifications

Trade name	Common name	Classification
*Aastar	flucythrinate + phorate	restricted
*Ambush	permethrin	restricted
*Asana	esfenvalerate	restricted
Broot	trimethacarb	general
*Counter	terbufos	restricted
Cygon	dimethoate	general
Cythion	malathion	general
Diazinon	diazinon	general
Dipel	*Bacillus thuringiensis*	general
*Dyfonate	fonofos	restricted
Dylox	trichlorfon	general
*Force	tefluthrin	restricted
*Furadan	carbofuran	restricted
Imidan	phosmet	general
*Lannate	methomyl	restricted[a]
Larvin	thiodicarb	general
Lorsban	chlorpyrifos	general
Malathion	malathion	general
*Mocap	ethoprop	restricted
Orthene	acephate	general
*Penncap-M	methyl parathion (microencapsulated)	restricted
*Pounce	permethrin	restricted
*Pydrin	fenvalerate	restricted
Sevin	carbaryl	general
*Supracide	methidathion	restricted
*Thimet	phorate	restricted

[a] All formulations except water-soluble packages, 25% wettable powder, and granulars are restricted.

Asterisks (*) are used throughout this circular to indicate insecticides classified for "restricted" use.

commodity on property owned, rented, or otherwise controlled by them or their employer, or as exchange labor (no compensation) on the property of another must be certified by passing a written examination.

Certification via written examination and the issuing of permits or licenses are handled by the Illinois Department of Agriculture. Training programs for farmers (private applicators) and commercial pesticide applicators are conducted by the Cooperative Extension Service to prepare persons for certification. For additional information about training programs, consult your county Extension adviser in agriculture.

Special local need registrations

Section 24(c) of the amendments to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1972 allows states the right to register pesticides for use within the state to meet special local needs (SLN). The authority for state registration of pesticides is the Illinois Department of Agriculture. A special label, which lists the new 24(c) uses, is printed by the formulator. A copy of this label must be in the possession of the operator during application of the pesticides.

Emergency registrations

Section 18 of the amendments to FIFRA allows the U.S. EPA to exempt any federal or state agency from provisions of FIFRA if the EPA determines that emergency conditions exist. This section allows for the use of a pesticide not currently labeled for a particular crop if emergency conditions, such as an insect outbreak, exist. "The Administrator (of the U.S. EPA), in determining whether or not such emergency conditions exist, shall consult with the Secretary of Agriculture and the Governor of any State concerned if they request such determination."

Groundwater protection

The U.S. EPA has started requiring pesticide manufacturers to include groundwater statements on labels if the product has been detected in samples of groundwater associated with monitoring programs.

Most groundwater statements now on labels have identical wording: "*Pesticide X* is a chemical which can travel (seep or leach) through soil and can contaminate groundwater which may be used as drinking water. *Pesticide X* has been found in groundwater as a result of agricultural use. Users are advised not to apply *Pesticide X* where the water table (groundwater) is close to the surface and where the soils are very permeable, i.e., well-drained soils such as loamy sands. Your local agricultural agencies can provide further information on the type of soil in your area and the location of groundwater."

Groundwater statements that are present on labels help the applicator to choose appropriate treatments where soils are sandy or where extra precautions are needed to reduce the risk of groundwater contamination. Pesticide applicators should use alternative products in areas with sandy soils and shallow groundwater.

Currently, the only agricultural **insecticide** product that includes a groundwater statement on the label is Furadan.

The leaching potential of pesticides is affected by many properties, including how tightly they are adsorbed by soil particles, solubility, and persistence. Adsorptivity, solubility, and persistence properties of pesticides are usually not included on pesticide labels.

Endangered species act

In 1973, Congress passed the Endangered Species Act to protect America's endangered plants and wildlife. That act requires the U.S. EPA to ensure that these species are adequately protected from pesticides.

At the present time, it is working to develop an Endangered Species Protection Program in fulfillment of this mandate. The goal of this program will be to remove the potential hazard to endangered species posed by pesticide use. A concurrent goal of this agency is to avoid placing any unnecessary limitations on the use of many important pesticides.

Role of the EPA. The federal government has a clearly defined legal responsibility to protect native plants and animals from hazards posed by pesticides. The EPA's role, as defined by Congress, is to register pesticides and set conditions for their use. FIFRA, one of the EPA's principal statutes, charges the EPA with protecting the environment and health from "any unreasonable adverse effects" of pesticides. In addition, the Endangered Species Act requires all federal agencies to ensure that their actions do not jeopardize endangered species.

Program Implementation. The Endangered Species Protection Program will utilize a species-based approach to biological consultation. Species will be ranked based on their status, recovery potential, potential for exposure, the apparent risk to their continued existence from pesticides, and other factors which EPA deems a threat to their existence. EPA will first focus on the listed species with the greatest need for protection. They will gather information on the habitats and locations of these species and determine the pesticides to which the species may be exposed.

Once the species and associated pesticides have been selected for consideration, the species will be screened to determine whether the use of the pesticides may affect them. As part of this "may affect" determination, EPA will determine the lowest application rate of the pesticide that could affect a species or its habitat. EPA

will then request a consultation with the Fish and Wildlife Service (FWS) for the specific pesticide rates, methods, and uses that may affect listed species. The FWS will respond with a biological opinion indicating whether or not the species is in jeopardy from the pesticide use. If jeopardy is found, FWS and/or EPA will proceed to develop habitat maps that will become part of the pesticide labeling/bulletin instructions. Not all pesticides that EPA determines "may affect" a listed species will necessarily be found by the FWS to cause jeopardy to a species. Among other criteria, the jeopardy declaration can be based on an assessment of whether a species will actually be exposed to the pesticide in question.

The product label will not list the counties in which limitations on pesticide use apply. Instead, the labels of affected products will require users in all counties to comply with the use limitations contained in the bulletin for the county in which they intend to use the pesticide. In counties where no limitations apply, the bulletin will instruct users to follow label directions and will provide general information about listed species. For those counties where use limitations do apply, the bulletins will contain a county map showing the geographic area associated with each species of concern. The bulletins will identify the pesticides that jeopardize or involve incidental risk to these species and will describe the use limitations that apply. The bulletins will also contain an address for pesticide users to write to with comments and pertinent information.

The bulletins will be updated, if needed, not more than once annually. Distribution of the bulletins will be through the training and certification programs within the states as well as the county Extension offices, pesticide dealers and distributors, Soil Conservation Service field offices, and the offices of state regulatory agencies.

The Endangered Species Protection Program has been implemented during the 1989 and 1990 growing seasons on a voluntary basis. Presently 17 states are participating in the voluntary program. In January 1991, EPA will implement enforceable measures to protect listed species from pesticides. At that point, EPA will issue Pesticide Registration Notices to the registrants of affected pesticide products to modify the labeling of their products. All affected products released for shipment after a specified date will be required to carry a label statement directing the user of the product to adhere to the limitations in the bulletin.

EPA will implement the program in phases, beginning with a review and update of existing biological opinions. This "catch-up" effort is essential in order to fulfill the agency's legal obligations under the Endangered Species Act with respect to the existing biological opinions.

The second phase will involve consultations on all remaining listed species and registered pesticides. Thereafter, EPA will operate in a "maintenance" phase, evaluating new information, new pesticides or uses, and new species as they are listed. Because EPA is proposing a generic label statement that will not include lists of counties, registrants will not need to change their product labels if use limitations change. Label changes will be necessary only if reasonable and prudent actions are changed for all uses of a product. At present, EPA is proposing to include household products in the program, and they are trying to determine how best to provide homeowners with pertinent information on species and appropriate protective measures.

Importance of Protecting the Endangered Species. Biological diversity is essential for a healthy environment. Removing a single species can directly or indirectly affect many others that rely on it during all or part of its life cycle. It has been estimated, for example, that the disappearance of one plant can take with it 30 other species, including insects, higher animals, and even other plants.

Biologists know that today's danger to wildlife most often results from habitat destruction, environmental pollution, the introduction of nonnative organisms, and exploitation — all generally the direct result of human activity. Scientists also believe that certain pesticides may pose a threat to the survival of some of America's endangered species if used in their remaining habitats.

Pesticide Labels and Safety

Certain precautionary steps should be taken when handling insecticides. The insecticides suggested in this publication can be poisonous to the applicators, the people most likely to suffer ill effects from insecticides. Farmers or applicators are expected to protect themselves, their workers, and their families from needless exposure.

When using insecticides, apply all the scientific knowledge available to make sure that there will be no illegal residue on the marketed crop. Such knowledge is condensed on the label. **Read the label carefully and follow the instructions. The label is the law.** The label should be recent and not from a container several years old. Do not exceed the maximum rates suggested. Observe the interval between application and harvest. Apply only to crops for which use has been approved. Keep records of pesticide use for each field. Record the product used, the trade name, the percentage content of the insecticide, the dilution, the rate of application per acre, and the date or dates of application.

Always handle insecticides with respect. Accidents and careless, needless overexposure can be avoided. Following these rules will prevent most insecticide accidents:

- When using any pesticide, regardless of its toxicity, wear at least a hat, long-sleeved shirt, long-legged trousers or a coverall garment, and socks and shoes.

- Wear rubber boots, rubber gloves, a rubber or vinyl apron, and goggles when handling insecticide concentrates.
- If at all possible, mix insecticides in a place out-of-doors where there are good light and ventilation.
- Keep your face turned to one side when opening, pouring from, or emptying insecticide containers.
- If you splash or spill an insecticide on yourself while mixing or loading, stop immediately, remove contaminated clothing, and wash yourself thoroughly with soap and water.
- Do not smoke, eat, or drink while handling or using insecticides.
- Do not put the water supply hose directly into the spray tank.
- Never leave a spray tank unattended while it is being filled.
- Do not leave puddles of insecticide mixture on impervious surfaces or apply insecticides near dug wells or cisterns.
- Do not blow out clogged nozzles or spray lines with your mouth.
- Avoid spraying near beehives, lakes, streams, pastures, houses, schools, playgrounds, hospitals, or sensitive crops whenever possible. If these areas must be sprayed, do not spray on windy days, and always spray downwind from the sensitive area.
- Do not apply insecticides when drift is likely to occur.
- Do not apply insecticides to fish-bearing or other waters.
- Do not apply insecticides to areas with abundant wildlife.
- To avoid killing bees, apply insecticides early in the morning or late in the evening when bees are not actively foraging. If at all possible, use the insecticide that is least toxic to bees. Before you begin application, warn beekeepers that you are applying insecticides.
- Change clothes and take a shower every day after insecticide application.
- If contamination occurs while using an insecticide, change clothes and shower immediately.
- Keep contaminated clothing away from the family laundry.
- Leave unused insecticides in their original containers with the labels on them.
- If at all possible, buy no more insecticide than you will use, thus eliminating problems with insecticide storage and disposal.
- Store insecticides out of the reach of children, irresponsible persons, and animals, preferably in a locked building marked for insecticide storage. Do not store insecticides near livestock feeds.
- Triple rinse, bury, or burn all empty insecticide containers or take them to an appropriate sanitary landfill.

Refer to the *Illinois Pesticide Applicator Study Guide* for more information concerning safe handling of pesticides and treatment of pesticide poisoning.

Poison Resource Centers

The Poison Resource centers listed below have been established to provide information about the treatment of poisoning cases. Anyone with a poisoning emergency can call the toll-free telephone number for help. Personnel at the Poison Resource Center will provide first-aid information and refer callers to local treatment centers if necessary.

Poison Resource centers supplement, but do not replace, local emergency medical services. Do not delay calling local emergency medical personnel to request immediate assistance or transportation. If possible, have the pesticide container and label present when you call or reach a treatment center or hospital.

Chicago and northeast Illinois
1753 West Congress Parkway
Chicago, Illinois 60612
Telephone: 800-942-5969

Northern and central Illinois
530 N.E. Glen Oak
Peoria, Illinois 61603
Telephone: 800-322-5330

Central and southern Illinois
800 East Carpenter
Springfield, Illinois 62702
Telephone: 800-252-2022

Soil Insecticides and Seed Treatments

Soil insecticides are often used in corn production to prevent damage by subterranean insects such as corn rootworms, cutworms, seedcorn maggots, white grubs, and wireworms. Seed treatments protect corn and soybean seeds from attack by seedcorn maggots and wireworms. Both soil insecticides and seed treatments are applied as preventive measures because rescue treatments are often ineffective against subterranean insect pests. However, whenever possible, these applications should be made based on scouting information or on the knowledge of frequency of occurrence of the different pests in different cropping sequences. The use of soil insecticides as "insurance" against soil insect pests is strongly discouraged.

In order for soil insecticides to be effective against the target insect you wish to control, proper calibration before application and placement during application are very important. Both the rates of application and placement vary among different soil insecticides for control

of the assorted soil insect pests. Tables 4 and 5 list the suggested rates of application and placement for the most frequently encountered soil insect pests of corn. However, before applying soil insecticides, consult the label to determine the appropriate rate and placement for the intended target pest.

Calibration for granular soil insecticides

Calibrate the applicators for granular soil insecticides before the planting season begins. In some instances, poor control is caused by applying rates that are too low. Proper calibration will help avoid this problem. Most soil insecticide bags have a list of suggested settings for the particular model of applicator. The settings are based on planting speed. The *beginning settings* are helpful, but be sure to check your actual application rate under your own operating conditions.

Follow these steps for calibrating the applicator:

1. Calibration of granular applicators for soil insecticides is usually based on ounces of product needed per 1,000 feet of row. Consult the insecticide label or Table 4 for labeled rates for rootworm control. These rates are expressed in ounces per 1,000 feet of row and in pounds of product per acre.
2. Consult the label or manufacturer's recommendation for an approximate application setting. Adjust the setting on each hopper.
3. Select an area for a test run, preferably in the field so that speed and traction conditions are constant. Measure off 1,000 feet.
4. Fill the hoppers and attach a plastic bag or container to each delivery tube to catch the granules from each hopper.
5. Drive the premeasured distance (1,000 feet) at the same speed to be used during the planting operation.
6. Weigh the material collected from each hopper. Use a scale that weighs in ounces (e.g., a postal scale or a diet scale).
7. Compare the weight (ounces) per bag against those given in Table 4. The following amounts of material should be collected:

Formulation, percent	Ounces collected per 1,000 feet
10	12
15	8
20	6

8. Recalibrate if the difference in the amount of insecticide applied during the calibration process is more than 10 percent over or under the rate suggested on the label.

Potential control problems with soil insecticides

A reduction in effectiveness of soil insecticides can be caused by numerous factors, including, but not restricted to, improper application, improper timing of application, dry soil conditions, excessive rainfall or wind moving the insecticide off target, extremely large insect population, enhanced degradation of the insecticide,

Table 4. Soil Insecticides for Rootworm Control, Illinois, 1990

Insecticide[a]	Time of application	Ounces of product per 1,000 ft. of row	Amount of product needed per acre			
			40″ rows	38″ rows	36″ rows	30″ rows
*Aastar G	At planting	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
Broot 15GX	At planting or cultivation	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
*Counter 15G	At planting or cultivation	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
*Counter 20CR	At planting or cultivation	6	5.0 lb.	5.3 lb.	5.6 lb.	6.7 lb.
*Dyfonate II	At planting or cultivation	6	5.0 lb.	5.3 lb.	5.6 lb.	6.7 lb.
*Dyfonate 4E	At planting	2.5 fl. oz.	2 pints	2⅛ pints	2¼ pints	2¾ pints
*Dyfonate 4E	Preplant	Broadcast	3 quarts	3 quarts	3 quarts	3 quarts
*Force 1.5G	At planting	8-10	6.7-8.3 lb.	7.0-8.6 lb.	7.4-9.1 lb.	8.7-10.9 lb.
*Furadan 15G	At planting or cultivation	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
*Furadan 4F	At planting or cultivation	2.5 fl. oz.	2 pints	2⅛ pints	2¼ pints	2¾ pints
Lorsban 15G	At planting or cultivation	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
Lorsban 4E	At cultivation	2.5 fl. oz.	2 pints	2⅛ pints	2¼ pints	2¾ pints
Lorsban 4E	Preplant	Broadcast	6 pints	6 pints	6 pints	6 pints
*Mocap 15G	At planting or cultivation	8	6.7 lb.	7.0 lb.	7.4 lb.	8.7 lb.
*Thimet 20G	At planting or cultivation	6	5.0 lb.	5.3 lb.	5.6 lb.	6.7 lb.

[a] Consult text for more information. LIQUID FORMULATIONS ARE HIGHLY TOXIC.
* Use restricted to certified applicators only.

and insect resistance. Because these products are applied to the soil, usually well before the target insect occurs in the field, they are subjected to numerous environmental and biological forces before they become active against the target pest. Soil insecticides usually provide acceptable insect control under a wide array of conditions. But occasionally growers encounter a lack of control of the target insect by the insecticide they have selected. A recent history of problems with soil insecticides intended to control corn rootworms is a case in point.

Corn rootworm larval control with soil insecticides has been variable in Illinois during the past few years, in both farmers' fields and research trials. Instances of poor control have been observed with all rootworm soil insecticides over a wide geographical area with various soil types and weather conditions. An investigation of some of the problem fields has disclosed several factors that probably contributed to poor control with the insecticides. The factors that stand out but are not easily quantifiable include dry soil conditions during May, June, and July, above-average rootworm larval populations, and improper calibration of equipment (rates that were too low).

In many areas, lack of rain prevented the movement of the insecticide off the granular carrier to the area where rootworm larvae were feeding. Early planting also may have been a contributing factor in some fields because soil insecticides applied in April could have lost much of their potency by the time eggs hatched. Undoubtedly, several of these conditions in combination could have affected the performance of soil insecticides.

Unfortunately the factors that influence the performance of soil insecticides under field conditions are not well understood. Recent research indicates that the breakdown of some soil insecticides by soil microorganisms is accelerated after repeated applications of the same compound. The soil microorganisms use the insecticide as an energy source. As a result, the insecticide has a progressively shorter residual time in the soil. This seems to be most prevalent in fields where the same soil insecticide has been used for several consecutive years; however, the pattern is neither clear-cut nor predictable. In all probability, environmental conditions combined with accelerated degradation of the insecticides are causes for rootworm control problems.

Are the rootworms resistant to the soil insecticides? Although this has not been confirmed, some research data suggest that some slight change in susceptibility has occurred with some compounds. At this point, resistance to insecticides cannot be ruled out, but widespread control failures are not likely caused by resistance.

Because potential control problems can occur through misuse or overuse of soil insecticides, growers should take great care when using these insect control tools in crop production sytems. Soil insecticides should be used only when necessary to prevent damage from a known soil insect pest. Continued use and overapplication of soil insecticides, particularly of the same product, for several consecutive years may cause insect resistance in the target population or accelerated microbial degradation. Soil insecticides should only be used to supplement a complete insect management program that integrates other control alternatives.

Chemical injury to soybeans

There have been instances of phytotoxicity to soybeans when organophosphate soil insecticides were used. The problems have occurred where growers started planting soybeans without first emptying the insecticide boxes. Organophosphate soil insecticides applied in soybean fields treated with Sencor or Lexone may cause injury to a soybean crop, according to information on the labels.

Planter-box seed treatments

Corn. Consider using a seed treatment in fields that do not receive a soil insecticide at planting time. A planter-box seed treatment containing diazinon will protect germinating corn against attack by seedcorn beetles and maggots. A lindane or diazinon + lindane planter-box seed treatment protects seed from attack by seedcorn maggots, seedcorn beetles, and wireworms. Lorsban 50-SL is labeled as a slurry treatment on seed before planting to protect germinating seed against injury by seedcorn maggots and beetles. NOTE: Excess dust from the seed treater may interfere with the electronic monitor in air planters.

Some seed may have already been treated with a combination of insecticide and fungicide. Addition of diazinon + lindane may cause planter units to gum up. Consult your seed or insecticide dealer to obtain specific information about seed treatment combinations.

Soybeans. Consider using a diazinon or diazinon + lindane seed protectant to prevent damage to germinating soybeans from seedcorn maggots. Follow the label directions for application. Potential damage is greatest during cool, wet springs when germination is slow.

Table 5. Insecticides for Field Corn

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Armyworms (True)	*Ambush 2E *Asana XL Dylox 80SP Lorsban 4E malathion 57%EC *Penncap-M *Pounce 3.2EC *Pydrin 2.4EC Sevin XLR Plus	6.4-12.8 oz. 5.8-9.6 oz. 10-20 oz. 1-2 pt. 1½-2 pt. 2-3 pt. 4-8 oz. 5⅓-10⅔ oz. 2-4 pt.	Broadcast	Seedling corn: Control is justified when 25 percent of the plants are being damaged. After pollen shed: Control is justified when the armyworms are eating leaves above ear level.
Billbug	Lorsban 4E	2-3 pt.	Broadcast	Apply as a postemergence rescue treatment with ground equipment.
Chinch bug	*Asana XL Lorsban 4E *Pydrin 2.4EC Sevin XLR Plus	5.8-9.6 oz. 2-3 pt. 5⅓-10⅔ oz. 2-4 pt.	Spray at base of plant.	Treat border rows at the start of migration from small grains. Use only ground equipment and apply 20 to 40 gallons of finished spray per acre.
Corn earworm	*Ambush 2E *Asana XL *Pounce 3.2EC *Pydrin 2.4EC	6.4-12.8 oz. 5.8-9.6 oz. 4-8 oz. 5⅓-10⅔ oz.	Overall spray or directed toward ear zone	Justified only in seed corn fields. Treatments are rarely effective for the control of earworms after worms enter ear tips.
Corn leaf aphid	Cygon 400 Lorsban 4E malathion 57%EC *Penncap-M	⅔-1 pt. 1-2 pt. 1½ pt. 2-3 pt.	On foliage	Apply during late whorl to early tassel when 50% of plants have light to moderate infestations and plants are under drouth stress.
Corn rootworm beetles	*Ambush 2E *Asana XL Cygon 400 Imidan 50WP Lorsban 4E malathion 57%EC *Penncap-M *Pounce 3.2EC *Pydrin 2.4EC Sevin XLR Plus	6.4-12.8 oz. 5.8-9.6 oz. ⅔-1 pt. ½-1 lb. 1-2 pt. 1½ pt. 1-2 pt. 4-8 oz. 5⅓-10⅔ oz. 2 pt.	Overall spray or directed toward ear zone	To protect pollination, treat if there are 5 or more beetles per plant, pollination is not complete, and if silk clipping is observed. Apply Ambush or Pounce prior to the brown silk stage.
Corn rootworm larvae	*Aastar G Broot 15GX *Counter 15G *Counter 20CR *Dyfonate II *Dyfonate 4E *Dyfonate 4E *Force 1.5G *Furadan 15G *Furadan 4F Lorsban 15G Lorsban 4E *Mocap 15G *Thimet 20G	8 oz. per 1,000 ft. row 8 oz. per 1,000 ft. row 8 oz. per 1,000 ft. row 6 oz. per 1,000 ft. row 6 oz. per 1,000 ft. row 6 pt. 2.5 fl. oz. per 1,000 ft. row 8-10 oz. per 1,000 ft. row 8 oz. per 1,000 ft. row 2.5 fl. oz. per 1,000 ft. row 8 oz. per 1,000 ft. row 6 pt. 8 oz. per 1,000 ft. row 6 oz. per 1,000 ft. row	Band Band Band, furrow Band, furrow Band Broadcast-PPI[d] Band Band, furrow Band, furrow Band Band Broadcast-PPI[d] Band Band	At planting. Broot 15GX, Counter 15G, Counter 20CR, Dyfonate II, Furadan 15G and 4F, Lorsban 15G and 4E, Mocap 15G, and Thimet 20G can also be applied at cultivation time.

Table 5. Insecticides for Field Corn (continued)

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Cutworms	*Ambush 2E	6.4-12.8 oz.	PE[d]	Apply as a postemergence rescue treatment when 3 percent or more of the plants are cut and larvae are still present.
	*Asana XL	5.8-9.6 oz.	PE[d]	
	Lorsban 4E	1-2 pt.	PE[d]	
	*Pounce 3.2EC	4-8 oz.	PE[d]	
	*Pydrin 2.4EC	5⅓-10⅔ oz.	PE[d]	
	*Aastar G	8 oz. per 1,000 ft. row	Band	These preventive treatments are probably best utilized in no-till corn where vegetation was plentiful during the cutworms' egg-laying period, or in fields that have to be replanted because cutworm damage to the original stand was severe.
	*Ambush 2E	6.4-12.8 oz.	PRE[c]	
	*Asana XL	5.8-9.6 oz.	PRE[c]	
	*Dyfonate II	6 oz. per 1,000 ft. row	Band	
	*Force 1.5G	8-10 oz. per 1,000 ft. row	Band, furrow	
	Lorsban 4E	1-2 pt.	PRE[c]	
	Lorsban 4E	2-4 pt.	BC-PPI[c]	
	Lorsban 15G	8 oz. per 1,000 ft. row	Band, furrow	
	*Mocap 15G	8 oz. per 1,000 ft. row	Band	
	*Pounce 1.5G	8-16 oz. per 1,000 ft. row	Band	
	*Pounce 1.5G	6.7-13.3 lb.	PRE[c]	
	*Pounce 3.2EC	4-8 oz.	PRE[c]	
	*Pydrin 2.4EC	5⅓-10⅔ oz.	PRE[c]	
European corn borer, first generation	*Ambush 2E	6.4-12.8 oz.	On upper ⅓ of plant and into whorl	See "Treatment Guidelines" under European Corn Borer, first generation. Granular formulations are more effective than sprays when applied by air for control of first-generation borers. Sprays are most effective when directed by ground equipment over the row, rather than broadcast. Apply Dipel ES only by ground equipment or center pivot irrigation.
	Dipel 10G	10 lb.		
	Dipel ES	2 pt.		
	*Dyfonate II	5 lb.		
	*Furadan 15G	6.7 lb.		
	*Furadan 4F	2 pt.		
	Lorsban 4E	1½-2 pt.		
	Lorsban 15G	5-6.5 lb.		
	*Penncap-M	4 pt.		
	*Pounce 3.2EC	4-8 oz.		
	*Pounce 1.5G	6.7-13.3 lb.		
European corn borer, second generation	*Ambush 2E	6.4-12.8 oz.	On foliage	See "Treatment Guidelines" under European Corn Borer, second generation. Apply Ambush 2E or Pounce 3.2EC prior to the brown silk stage.
	Dipel 10G	10 lb.		
	Dipel ES	2 pt.		
	*Dyfonate II	5 lb.		
	*Furadan 15G	6.7 lb.		
	*Furadan 4F	2 pt.		
	Lorsban 15G	5-6.5 lb.		
	Lorsban 4E	2 pt.		
	*Penncap-M	4 pt.		
	*Pounce 3.2EC	4-8 oz.		
	*Pounce 1.5G	6.7-13.3 lb.		
Fall armyworm	Dylox 80SP	10-20 oz.	On foliage	Treat when 35% of plants have whorl damage and if worms are present. Ground sprays directed over the row are more effective than broadcast sprays. Treatments to control worms in ear tips are not effective.
	Lannate 90WSP	½ lb.		
	Lorsban 4E	2 pt.		
Flea beetles	*Ambush 2E	6.4-12.8 oz.	Over row as spray	When leaves on seedling plants are severely damaged and plants are being killed.
	*Asana XL	5.8-9.6 oz.		
	Lorsban 4E	2 pt.		
	*Penncap-M	2-3 pt.		
	*Pounce 3.2EC	4-8 oz.		
	*Pydrin 2.4EC	5⅓-10⅔ oz.		
	Sevin XLR Plus	2 pt.		
Grasshoppers	*Asana XL	5.8-9.6 oz.	On foliage	Treatment may be warranted when there are 7 or more grasshoppers per square yard. After pollen shed, control is justified when grasshoppers are feeding on leaves above ear level. The higher rates are suggested for control of adult grasshoppers.
	Cygon 400	1 pt.		
	*Furadan 4F	¼-½ pt.		
	Lorsban 4E	½-1 pt.		
	malathion 57%EC	1½ pt.		
	*Penncap-M	1-3 pt.		
	*Pydrin 2.4EC	5⅓-10⅔ oz.		
	Sevin XLR Plus	1-3 pt.		

Table 5. Insecticides for Field Corn (continued)

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Japanese beetle	Sevin XLR Plus	2 pt.	On foliage	During the silking period to protect silks if there are 3 or more beetles per ear and pollination is not complete.
Picnic, sap beetles	Lannate 90WSP malathion 57%EC Sevin XLR Plus	¼-½ lb. 1½ pt. 2 pt.	On foliage	Justified only in seed corn fields when beetles are causing significant injury to ear tips.
Seedcorn beetles	diazinon diazinon + lindane Lorsban 50-SL	See label See label See label	On seed On seed On seed	Use formulations that are prepared as seed treaters. See label for proper disposal of treated seeds. Aastar, Counter 15G and 20CR, Dyfonate II, Force 1.5G, Lorsban 20G, and Thimet 20G are also labeled for seedcorn beetle control.
Seedcorn maggots	diazinon diazinon + lindane Lorsban 50-SL	See label See label See label	On seed On seed On seed	Use formulations that are prepared as seed treaters. Seed treatments should be considered for fields that do not receive a soil insecticide at planting. See label for proper disposal of treated seeds. Aastar, Counter 15G and 20CR, Dyfonate II, Force 1.5G, Furadan 15G, Lorsban 15G, and Thimet 20G are also labeled for seedcorn maggot control.
Sod webworm	Lorsban 4E	1-2 pt.	Broadcast	At time of initial attack.
Southwestern corn borer	*Ambush 2E *Dyfonate II *Furadan 15G *Furadan 4F Lorsban 15G Lorsban 4E *Penncap-M *Pounce 3.2EC *Pounce 1.5G	6.4-12.8 oz. 5 lb. 6.7 lb. 2 pt. 6.5 lb. 2 pt. 4 pt. 4-8 oz. 6.7-13.3 lb.	On foliage	Direct granules over row. Apply when 25% of the plants have egg masses or larvae on leaves. Early planted corn usually escapes damage. Sprays are most effective when directed over the row, rather than broadcast. Apply Ambush 2E or Pounce 3.2EC prior to the brown silk stage.
Spider mites	Cygon 400	1 pt.	On foliage	Begin control if the majority of plants are infested with mites severe enough to cause some yellowing or browning of the lower leaves before dent stage.
Stalk borer	*Ambush 2E *Asana XL Lorsban 4E *Pounce 3.2EC *Pydrin 2.4EC	6.4-12.8 oz. 5.8-9.6 oz. 2-3 pt. 4-8 oz. 5⅓-10⅔ oz.	Broadcast	Apply postemergence sprays when young larvae are moving from weed hosts to corn. See labels for more specific instructions about effective control.
Thrips	malathion 57%EC	1½ pt.	On foliage	When severe wilting and yellowing of leaves are noticed.
White grubs	*Aastar G *Counter 15G *Counter 20CR Lorsban 15G Lorsban 4E *Thimet 20G	8 oz. per 1,000 ft. row 8 oz. per 1,000 ft. row 6 oz. per 1,000 ft. row 8-16 oz. per 1,000 ft. row 4 pt. 6 oz. per 1,000 ft. row	Band Band, furrow Band, furrow Furrow Broadcast-PPI[d] Band	At planting, if crop history and previous crop losses can be directly linked to a repeated history of grub problems. Furadan 15G is labeled to aid in the control of white grubs, and Dyfonate II, Mocap 15G, and Force 1.5G are labeled for their suppression.

Table 5. Insecticides for Field Corn (continued)

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Wireworms	*Aastar G	8 oz. per 1,000 ft. row	Band	At planting, if crop history and/or bait stations indicate a potential for wireworm damage. Dyfonate II and Force 1.5G are labeled for suppression of wireworms.
	*Counter 15G	8 oz. per 1,000 ft. row	Band, furrow	
	*Counter 20CR	6 oz. per 1,000 ft. row	Band, furrow	
	*Dyfonate 4E	8 pt.	Broadcast-PPI[d]	
	*Furadan 4F	2.5 oz. per 1,000 ft. row	Furrow	
	*Furadan 15G	8 oz. per 1,000 ft. row	Band, furrow	
	Lorsban 15G	16 oz. per 1,000 ft. row	Band, furrow	
	Lorsban 4E	4 pt.	Broadcast-PPI[d]	
	*Mocap 15G	8 oz. per 1,000 ft. row	Band	
	*Thimet 20G	6 oz. per 1,000 ft. row	Band	
	lindane	See label	On seed	Use formulations that are prepared as seed treaters. See label for proper disposal of treated seeds.
	diazinon + lindane	See label	On seed	
Woollybear caterpillars	None labeled	. .	. . .	Silk clipping caused by caterpillars does not generally warrant control.

* Use restricted to certified applicators only.
[a] See Table 12 for insecticide restrictions.
[b] The formulation of the product most commonly used in Illinois is listed. If you use another formulation, READ THE LABEL to determine the amount of product per acre.
[c] PPI Preplant incorporated.
[d] PE Postemergent application.
[e] PRE Preemergent application.

Table 6. Insecticides for Soybeans

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Bean leaf beetle	*Ambush 2E	3.2-6.4 oz.	On foliage	**Seedlings:** Treat if 20% of the plants are cut and the stand has gaps of 1 foot or more; or treat if at least 1 seedling per foot of row is destroyed. This level of damage usually requires 5 or more beetles per foot of row. **Before bloom:** when defoliation reaches 30% and there are 5 or more beetles per foot of row. **Bloom to pod fill:** when defoliation reaches 20% and there are 16 or more beetles per foot of row. **Seed maturation:** when 5 to 10% of the pods are damaged, the leaves are green, and there are 10 or more beetles per foot of row.
	*Asana XL	5.8-9.6 oz.		
	Cygon 400	1 pt.		
	Larvin 3.2F	18-30 oz.		
	Lorsban 4E	1-2 pt.		
	Orthene 75S	⅔ lb.		
	*Penncap-M	2-3 pt.		
	*Pounce 3.2EC	2-4 oz.		
	*Pydrin 2.4EC	5⅓ oz.		
	Sevin XLR Plus	1-2 pt.		
Blister beetles	Sevin XLR Plus	1-2 pt.	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
Corn earworm	*Ambush 2E	6.4-12.8 oz.	On foliage	Damage occurs when larvae feed on pods. Apply control if populations exceed 1 per foot of row and 5 to 10% of the pods are damaged.
	*Asana XL	5.8-9.6 oz.		
	Larvin 3.2F	10-16 oz.		
	Orthene 75S	1⅓ lb.		
	*Pounce 3.2EC	4-8 oz.		
	*Pydrin 2.4EC	5⅓-10⅔ oz.		
Cutworms	*Asana XL	5.8-9.6 oz.	Broadcast	Scout as plants are emerging. Treat if 20% of plants are cut, stand has gaps of one foot or more, and cutworms are present.
	Larvin 3.2F	20-30 oz.		
	Lorsban 4E	2 pt.		
	*Pounce 3.2EC	2-4 oz.		
	*Pydrin 2.4EC	5⅓-10⅔ oz.		

Table 6. Insecticides for Soybeans (continued)

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Grasshoppers	*Asana XL Cygon 400 *Furadan 4F Lorsban 4E Orthene 75S *Penncap-M *Pydrin 2.4EC Sevin XLR Plus	5.8-9.6 oz. 1 pt. ¼-½ pt. ½-1 pt. ⅓-⅔ lb. 1-3 pt. 5⅓-10⅔ oz. 1-3 pt.	On foliage	When migration into fields begins and defoliation or pod feeding reaches economic levels. When defoliation reaches 30% before bloom and 20% between bloom and pod fill. When 5 to 10% of the pods are damaged. The higher rates are suggested for control of adult grasshoppers.
Green clover-worm	*Ambush 2E *Asana XL Dipel Larvin 3.2F Lorsban 4E Orthene 75S *Penncap-M *Pounce 3.2EC *Pydrin 2.4EC Sevin XLR Plus	3.2-6.4 oz. 2.9-5.8 oz. See label 10-16 oz. ½-1 pt. ⅔ lb. 2-3 pt. 2-4 oz. 2⅔-5⅓ oz. 1-2 pt.	On foliage	When defoliation occurs during blooming, pod set, and pod fill. Usually requires 12 or more half-grown worms per foot of row and 20% defoliation to justify treatment.
Japanese beetle adults	*Asana XL *Penncap-M *Pydrin 2.4EC Sevin XLR Plus	5.8-9.6 oz. 3-4 pt. 5⅓-10⅔ oz. 2 pt.	On foliage	When defoliation reaches 20% during bloom and pod fill.
Loopers	*Ambush 2E *Asana XL Larvin 3.2F Orthene 75S *Pounce 3.2EC *Pydrin 2.4EC Dipel	3.2-6.4 oz. 5.8-9.6 oz. 18-30 oz. ⅔-1⅓ lb. 2-4 oz. 5⅓-10⅔ oz. See label	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
Mexican bean beetle	*Ambush 2E *Asana XL Cygon 400 *Furadan 4F Larvin 3.2F Lorsban 4E Orthene 75S *Penncap-M *Pounce 3.2EC *Pydrin 2.4EC Sevin XLR Plus	3.2-6.4 oz. 2.9-5.8 oz. 1 pt. 1 pt. 18-30 oz. 1 pt. ⅔ lb. 2-3 pt. 2-4 oz. 2⅔-5⅓ oz. 1-2 pt.	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
Potato leafhopper	*Ambush 2E *Asana XL Cygon 400 *Penncap-M *Pounce 3.2EC *Pydrin 2.4EC Sevin XLR Plus	3.2-6.4 oz. 2.9-5.8 oz. 1 pt. 2-3 pt. 2-4 oz. 2⅔-5⅓ oz. 2 pt.	On foliage	When leafhoppers are numerous and the edges of the leaves appear burned.
Seedcorn maggot	diazinon diazinon + lindane	See label See label	On seed On seed	At planting time. Use formulations that are prepared as seed treaters. See label for proper disposal of treated seeds.
Spider mites	Cygon 400 Dimethoate 400 Lorsban 4E	1 pt. 1 pt. ½-1 pt.	On foliage	When symptoms of injury appear and mites are present.
Stink bugs	*Asana XL Lorsban 4E Orthene 75S *Penncap-M *Pydrin 2.4EC	5.8-9.6 oz. 2 pt. 1-1⅓ lb. 2-3 pt. 5⅓-10⅔ oz.	On foliage	When adult bugs or large nymphs reach 1 per foot of row during pod fill.

Table 6. Insecticides for Soybeans (continued)

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Thistle caterpillar	Sevin XLR Plus	3-4 pt.	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
Thrips	*Penncap-M Sevin XLR Plus	2-3 pt. 2 pt.	On foliage	If seedlings are being seriously damaged and some plants are being killed.
Webworms	Sevin XLR Plus	2-3 pt.	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.
Whitefly	None labeled	..	...	High infestations are occasionally present on double-crop soybeans, but are rarely economic.
Woollybear caterpillars	*Ambush 2E *Asana XL Larvin 3.2F Lorsban 4E *Pounce 3.2EC *Pydrin 2.4EC	3.2-6.4 oz. 2.9-5.8 oz. 10-16 oz. 1-2 pt. 4 oz. 2⅓-5⅔ oz.	On foliage	When defoliation reaches 30% before bloom and 20% between bloom and pod fill.

* Use restricted to certified applicators only. [a] See Table 12 for insecticide restrictions.
[b] The formulation of the product most commonly used in Illinois is listed. If you use another formulation, READ THE LABEL to determine the amount of product per acre.

Spraying blossoming soybeans can be extremely hazardous to bees. Coordinate with local beekeepers before applying sprays. Beekeepers' names and colony locations may be obtained from your County Extension Office.

Table 7. Insecticides for Alfalfa
To avoid injury to bees, do not spray alfalfa during bloom or if weeds are blooming.

Insect	Insecticide[a,b,c]	Amount of product per acre[c]	Placement	Timing of application, comments
Alfalfa caterpillar	*Ambush 2E Dipel Dylox 80SP *Pounce 3.2EC Sevin XLR Plus	3.2-12.8 oz. See label 8-10 oz. 2-8 oz. 2 pt.	On foliage	When damage to foliage is obvious and there are at least 10 nonparasitized larvae per sweep.
Alfalfa weevil (spring treatment for larvae)	*Ambush 2E *Furadan 4F Imidan 50WP Lorsban 4E[d] *Penncap-M *Pounce 3.2EC *Supracide 2E	12.8 oz. ½-1 pt. 2 lb. 2 pt. 2-3 pt. 8 oz. 2 pt.	On foliage	Refer to Circular 1136. Or when 25% to 40% of tips are being skeletonized and if there are 3 or more larvae per stem, treat immediately. Do not apply sprays during bloom. Instead, cut and remove the hay. Two treatments may be necessary on first cutting. Control may also be warranted after a cutting when larvae and adults are feeding on more than 50% of the crowns and regrowth is prevented for 3 to 6 days.
Alfalfa weevil adults	*Furadan 4F Imidan 50WP Lorsban 4E[d] *Penncap-M	1-2 pt. 2 lb. 1-2 pt. 2-3 pt.	On foliage	Control may be warranted after a cutting when larvae and adults are feeding on more than 50% of the crowns and regrowth is prevented for 3 to 6 days.
Aphids	*Ambush 2E Cygon 400 *Furadan 4F Lorsban 4E[d] malathion 57%EC *Penncap-M *Pounce 3.2EC *Supracide 2E	3.2-12.8 oz. ½-1 pt. ½ pt. ½ pt. 1½ pt. 2 pt. 2-8 oz. 2 pt.	On foliage	When aphids average 100 or more per sweep and lady beetle larvae and adults, parasites, and diseases are not abundant.

Table 7. Insecticides for Alfalfa (continued)

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Blister beetles	Sevin XLR Plus	1-2 pt.	On foliage	Although blister beetles rarely cause economic damage to alfalfa, their presence in hay could injure horses if the horses ingest the beetles.
Cutworms	*Ambush 2E	3.2-12.8 oz.	On foliage	Control may be warranted when larvae reduce the stand of a new seeding or prevent regrowth after harvest.
	Dylox 80SP	10-20 oz.		
	Lorsban 4E[d]	2 pt.		
	*Pounce 3.2EC	2-8 oz.		
	Sevin XLR Plus	2-3 pt.		
Fall armyworm	Dylox 80SP	20 oz.	On foliage	Control may be warranted when larvae reduce the stand of a new seeding, when there are 2 or more larvae per sweep, or when there are 1 to 2 half-grown larvae per square foot.
	Lorsban 4E[d]	2 pt.		
	Sevin XLR Plus	2 pt.		
Grasshoppers	Cygon 400	½-1 pt.	On foliage	When grasshoppers are small, before damage is severe, and there are 15 to 20 per square yard. The higher rates are suggested for control of adult grasshoppers.
	*Furadan 4F	¼-½ pt.		
	Imidan 50WP	3-4 lb.		
	Lorsban 4E[d]	½-1 pt.		
	*Penncap-M	1-3 pt.		
	Sevin XLR Plus	1-3 pt.		
Leafhoppers	*Ambush 2E	3.2-12.8 oz.	On foliage	Treatment is justified at these combinations of alfalfa height and leafhopper numbers: Alfalfa height (inches) — Leafhoppers per sweep 0-3 — 0.2 3-6 — 0.5 6-12 — 1.0 12 or taller — 1.5
	Cygon 400	½-1 pt.		
	Dylox 80SP	10-20 oz.		
	*Furadan 4F	1 pt.		
	Imidan 50WP	2 lb.		
	Lorsban 4E[d]	1-2 pt.		
	*Penncap-M	2-3 pt.		
	*Pounce 3.2EC	2-8 oz.		
	Sevin XLR Plus	2 pt.		
	*Supracide 2E	2 pt.		
Plant bugs	*Ambush 2E	6.4-12.8 oz.	On foliage	When tip damage is obvious and nymphs and adults average 3 per sweep on alfalfa less than 3 inches tall, or 5 per sweep on alfalfa taller than 3 inches.
	Cygon 400	½-1 pt.		
	Dylox 80SP	20 oz.		
	*Furadan 4F	2 pt.		
	Lorsban 4E[d]	1-2 pt.		
	*Penncap-M	2-3 pt.		
	*Pounce 3.2EC	4-8 oz.		
	Sevin XLR Plus	2 pt.		
Spittlebug	*Ambush 2E	6.4-12.8 oz.	On foliage	When spittle masses are found and nymphs average more than 1 per stem.
	Imidan 50WP	2 lb.		
	Lorsban 4E[d]	1-2 pt.		
	malathion 57%EC	1½ pt.		
	*Penncap-M	2-3 pt.		
	*Pounce 3.2EC	4-8 oz.		
Webworms	*Ambush 2E	3.2-12.8 oz.	On foliage	Control may be warranted when larvae reduce the stand of a new seeding.
	Dylox 80SP	20 oz.		
	*Pounce 3.2EC	2-8 oz.		
	Sevin XLR Plus	2-3 pt.		

* Use restricted to certified applicators only. [a] See Table 12 for insecticide restrictions.
[b] Before applying insecticides, be certain to clean all herbicides out of equipment. During bloom, apply very late in day or, if possible, avoid application during bloom.
[c] The formulation of the product most commonly used in Illinois is listed. If you use another formulation, READ THE LABEL to determine the amount of product per acre.
[d] Young, tender, rapidly growing alfalfa may show some phytotoxic symptoms when treated with Lorsban 4E.

Spraying blossoming alfalfa can be extremely hazardous to bees. Coordinate with local beekeepers before applying sprays. Beekeepers' names and colony locations may be obtained from your County Extension Office.

Table 8. Insecticides for Grain Sorghum

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Chinch bug	Lorsban 4E[c] Sevin XLR Plus	2 pt. 2-4 pt.	At plant base	Use only ground equipment and apply 20 to 40 gallons of finished spray per acre.
Corn earworm	Lannate 90WSP Lorsban 4E Sevin XLR Plus	¼-½ lb. 2 pt. 2-4 pt.	Over row	When there is an average of 2 worms per head.
Corn leaf aphid	Cygon 400 Lorsban 4E[c] malathion 57%EC	½-1 pt. ½-1 pt. 1½ pt.	Over row	Corn leaf aphids rarely cause economic damage unless populations are heavy and drouth conditions exist.
Cutworms	Lorsban 4E[c] Sevin XLR Plus	2 pt. 4 pt.	Broadcast Broadcast	When seedling plants are being cut.
Fall armyworm	Lannate 90WSP Lorsban 4E[c]	¼-½ lb. 2 pt.	Over row	When there is an average of 2 worms per head. Leaf feeding or whorl damage is seldom economic.
Grasshoppers	Cygon 400 Lorsban 4E[c] Sevin XLR Plus	1 pt. ½-1 pt. 1-3 pt.	Over row	Treatment may be warranted when there are 7 or more per square yard. The higher rates are suggested for control of adult grasshoppers.
Greenbug	Cygon 400 Lorsban 4E[c] malathion 57%EC	½-1 pt. ½-1 pt. 1½ pt.	Over row	When greenbug damage is sufficient to cause death of more than 2 normal-sized leaves before the hard-dough stage. CAUTION: Some sorghum varieties are sensitive to organophosphate insecticides.
Sorghum midge	Lorsban 4E[c] Sevin XLR Plus	½ pt. 1½-2 pt.	Over row	Apply during bloom when 50% of heads have begun to bloom and there are 1 or more midge adults (flies) per head.
Webworms	Lorsban 4E[c] Sevin XLR Plus	2 pt. 2-4 pt.	Over row	When 5 or more larvae per head are found.
White grubs	*Counter 15G *Counter 20CR	8 oz. per 1,000 ft. row 8 oz. per 1,000 ft. row	Band Band	At planting, if crop history and previous crop losses can be directly linked to a repeated history of grub damage.
Wireworms	*Counter 15G *Counter 20CR *Furadan 15G	8 oz. per 1,000 ft. row 8 oz. per 1,000 ft. row 8 oz. per 1,000 ft. row	Band Band Furrow	At planting, if crop history and/or bait stations indicate a potential for wireworm damage.
	lindane	See label	On seed	Use seed treatment formulations. See label for proper disposal of treated seeds.
Yellow sugarcane aphid	Cygon 400 Lorsban 4E[c]	1 pt. ½-1 pt.	Over row	Sprays should be applied at first sign of damage to seedling sorghum; 5 to 10 aphids per leaf.

* Use restricted to certified applicators only.
[a] See Table 12 for insecticide restrictions.
[b] The formulation of the product most commonly used in Illinois is listed. If you use another formulation, READ THE LABEL to determine the amount of product per acre.
[c] To avoid phytotoxicity, do not treat plants that are under extreme heat and drouth stress.

Table 9. Insecticides for Small Grains (Barley, Oats, Rye, Wheat)

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Armyworm	Lannate 90WSP *Penncap-M Sevin XLR Plus	¼-½ lb. 2-3 pt. 2-3 pt.	On foliage	When there are 6 or more nonparasitized armyworms (¾-1¼ inch long) per linear foot of row and before extensive head cutting occurs. Do not use Penncap-M on rye.
Cereal leaf beetle	*Furadan 4F Lannate 90WSP malathion 57%EC Sevin XLR Plus	½ pt. ¼-½ lb. 1½ pt. 2 pt.	On foliage	When there are one or more small larvae per stem or flag leaf. Apply Furadan before heads emerge from the boot.

Table 9. Insecticides for Small Grains (Barley, Oats, Rye, Wheat) (continued)

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Fall armyworm	Sevin XLR Plus	2-3 pt.	On foliage	During fall when damage to new growth is apparent.
Grasshoppers	Cygon 400 *Furadan 4F malathion 57%EC *Penncap-M Sevin XLR Plus	¾ pt. ¼-½ pt. 1½ pt. 1-3 pt. 1-3 pt.	On foliage	During fall when damage is apparent, treat field borders and noncrop areas to stop migration. The higher rates are suggested for control of adult grasshoppers. Do not apply Penncap-M to rye.
Greenbug, English grain aphid, oat bird-cherry aphid	Cygon 400 Lannate 90WSP malathion 57%EC *Penncap-M	½-¾ pt. ¼-½ lb. 1½ pt. 1-2 pt.	On foliage	Aphids damage plants indirectly by transmitting disease. Once yellowing is noticeable, it is usually too late to treat. Use Cygon on wheat only. Do not apply Penncap-M to rye.
Wheat stem maggot	None	. .	. . .	No chemical control. Damage shows as white heads when field is still green.

* Use restricted to certified applicators only.
[a] See Table 12 for insecticide restrictions.
[b] The formulation of the product most commonly used in Illinois is listed. If you use another formulation, READ THE LABEL to determine the amount of product per acre.

Table 10. Insecticides for Grass Pasture

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Armyworms	malathion 57%EC *Penncap-M Sevin XLR Plus	2 pt. 2-3 pt. 2-3 pt.	On foliage	Do not apply when weeds are blooming.
Grasshoppers	malathion 57%EC *Penncap-M Sevin XLR Plus	1½ pt. 1-3 pt. 1-3 pt.	On foliage	When there are 15 to 20 per square yard. The higher rates are suggested for control of adult grasshoppers. Do not apply when weeds are blooming.

* Use restricted to certified applicators only.
[a] See Table 12 for insecticide restrictions.
[b] The formulation of the product most commonly used in Illinois is listed. If you use another formulation, READ THE LABEL to determine the amount of product per acre.

Table 11. Insecticides for Noncrop Areas

Insect	Insecticide[a,b]	Amount of product per acre[b]	Placement	Timing of application, comments
Grasshoppers	*Asana XL Imidan 50WP malathion 57%EC *Penncap-M *Pydrin 2.4EC Sevin XLR Plus	2.9-5.8 oz. 3-4 lb. 1½ pt. 1-3 pt. 2⅔-5⅓ oz. 1-3 pt.	On foliage	When grasshopper nymphs average 15 to 20 per square yard along roadsides and fence rows. Apply treatments while hoppers are small and before they migrate into row crops. The higher rates are suggested for control of adult grasshoppers. Do not spray areas adjacent to water or where runoff is likely to occur.

* Use restricted to certified applicators only. [a] See Table 12 for insecticide restrictions.
[b] The formulation of the product most commonly used in Illinois is listed. If you use another formulation, READ THE LABEL to determine the amount of product per acre.

To avoid injury to bees, do not apply sprays to noncrop areas if weeds are blooming.

Table 12. Harvest Restrictions: Limitations in Days between Application of the Insecticide and Harvest of Crop and Restrictions on Use of Insecticides for Field Crop Insect Control (These are only guidelines. Read the label for more detailed information.)

(Blanks denote that the product may not be labeled or suggested for that specific use in Illinois)

Insecticide	Field corn: Grain	Field corn: Ensilage	Grain Sorghum	Forage crops: Alfalfa	Forage crops: Clover	Forage crops: Pasture
*Aastar G (phorate + flucythrinate)	A	60	...	...	...	...
*Ambush 2E, 25W (permethrin)[a,b]	B	B	...	C	...	...
*Asana XL (esfenvalerate)	21,D	21,D	...	...	...	...
Broot 15GX (trimethacarb)	90	90	...	...	...	...
*Counter 15G, 20CR (terbufos)	E	30,E	F	...	...	...
Cygon 400 (dimethoate)[b]	14,G	14,G	28,G	10,H	...	...
Diazinon AG 500	A	A	7	10	10	0
Dipel (*Bacillus thuringiensis*)	A	A	...	...	...	...
*Dyfonate II, 4E (fonofos)[a,b]	30	30	...	...	...	...
Dylox 80SP (trichlorfon)	I	I	...	0,I	0,I	...
*Force 1.5G (tefluthrin)	J	J	...	...	...	...
*Furadan 15G, 4F (carbofuran)[a,b]	30,K,L	30,K,L	75	M	...	...
Imidan 50WP (phosmet)	14	14	...	7,H	...	...
Lannate 90WSP (methomyl)[a,b]	A	3	14	...	...	...
Lorsban 15G, 4E (chlorpyrifos)	35,N	14,N	60,P	21,Q	...	...
Malathion 57% EC	5	5	7	0	0	0
*Mocap 15G (ethoprop)	A	A	...	...	...	...
*Penncap-M (microencapsulated methyl parathion)[a,b]	12	12	...	15	...	15
*Pounce 3.2EC, 25WP, 1.5G (permethrin)[a,b]	R	R	...	C	...	...
*Pydrin 2.4EC (fenvalerate)[a,b]	21,S	21,S	...	...	...	...
Sevin XLR Plus (carbaryl)	0	0	21	7	0	5,T
*Supracide 2E (methidathion)[a,b]	...	...	...	10,U	...	...
*Thimet 20G (phorate)	30,V	30,V	...	...	...	...

Insecticide	Barley	Oats	Rye	Wheat	Soybeans	Sunflowers
*Ambush 2E, 25W (permethrin)[a,b]	...	...	...	...	60,W	...
*Asana XL (esfenvalerate)	...	...	...	...	21,X	...
Cygon 400 (dimethoate)[b]	...	...	...	60	21	...
Dipel, Thuricide, Bactur, SOK (*Bacillus thuringiensis*)	...	...	...	...	0	...
*Furadan 15G, 4F (carbofuran)[a,b]	Y	Y	...	Y	21,Z	28,AA
Lannate 90WSP (methomyl)[a,b]	7	7	7	7	...	...
Larvin 3.2F (thiodicarb)	...	...	...	...	28,BB	...
Lorsban 15G, 4E (chlorpyrifos)	...	...	...	...	28,CC	42,DD
Malathion 57% EC	7	7	7	7	0	...
Orthene 75S (acephate)	...	...	...	...	14,BB	...
*Penncap-M (microencapsulated methyl parathion)[a,b]	15	15	...	15	20,EE	...
*Pounce 3.2EC, 25WP (permethrin)[a,b]	...	...	...	...	60,W	...
*Pydrin 2.4EC (fenvalerate)[a,b]	...	...	...	...	21,FF	28,FF
Sevin XLR Plus (carbaryl)	...	...	...	21	0	60
*Supracide 2E (methidathion)[a,b]	...	...	...	...	...	50,BB

Read the label for more detailed information.

A. No specific restriction when used as recommended.

B. Apply prior to the brown silk stage.

C. Do not apply more than 0.2 pound active ingredient per cutting. When rates of 0.1 pound active ingredient per acre or less are used, application may be made on day of harvest. When rates greater than 0.1 pound active ingredient per acre are used, do not apply within 14 days of harvest. For aerial application, do not apply within 100 yards of aquatic habitats. For ground application, do not apply within 20 yards of aquatic habitats.

D. Do not exceed 0.25 pound of active ingredient per acre per season for field and seed corn. Do not exceed 0.5 pound of active ingredient per acre per season for popcorn.

E. Only one at planting, postemergence incorporated, or cultivation time treatment of Counter may be used.

F. Only one application per year may be used.

G. Make no more than 3 applications per year. Do not apply to corn during the pollen-shed period if bees are actively foraging in the treated area. Do not apply to sorghum after heading.

H. Apply only once per cutting; do not apply during bloom.

I. Three applications may be made per season on corn, and 3 applications may be made per cutting of alfalfa or grasses. Can be applied up to harvest.

J. Do not rotate to crops other than soybeans or corn. Soybeans may be planted 12 months after Force application. For ground application, do not apply this product within 20 yards of water (ponds, streams or lakes).

K. Do not make a foliar application if Furadan 15G was applied at more than 8 ounces per 1,000 linear feet of row (6.7 pounds per acre with 40-inch row spacing) at planting. Do not make more than 2 foliar applications of Furadan 15G per season.

L. Do not make more than 2 applications of Furadan 4F per season at the 1½ to 2-pint use rate. Do not make more than 4 applications per season at the 1-pint use rate. Do not apply Furadan 4F on seed corn less than 14 days prior to detasseling or rogueing. If prolonged, intimate contact with corn or sorghum foliage will result, do not reenter treated field within 14 days of application without wearing proper clothing. For all other situations do not reenter fields less than 24 hours following application unless appropriate clothing is worn.

M. Make no more than 2 applications per season. Do not apply more than twice per season. Do not apply more than once per cutting. Do not use more than 1 pint per acre in the second application. Apply only to fields planted to pure stands of alfalfa. When using no more than ¼ pound per acre, allow 7 days between application and harvest. When using ¼ to ½ pound per acre, allow 14 days between application and harvest. When using ½ to 1 pound per acre, allow 28 days between application and harvest. Do not move bees to alfalfa fields within 7 days of application.

N. For soil insect control, do not exceed the equivalent of 16 ounces of Lorsban 15G per 1,000 feet of row or 13.5 pounds of Lorsban 15G per acre per crop season. For foliar insect control, do not exceed the equivalent of 16 ounces of Lorsban 15G per 1,000 feet of row or 13 pounds of Lorsban 15G per acre per crop season. Do not apply more than a total of 15 pints of Lorsban 4E per acre per season. Do not allow livestock to graze in treated areas nor harvest treated corn silage as feed for meat or dairy animals within 14 days after last treatment. Do not feed treated corn fodder to meat or dairy animals within 35 days after last treatment.

P. The treated crop is not to be used for forage, fodder, hay, or silage within 30 days after application of 1 pint of Lorsban 4E per acre or within 60 days after application of rates above 1 pint per acre. Do not treat sweet varieties of sorghum. Do not apply more than 3 pints of Lorsban 4E per acre per season. Do not make more than one application of Lorsban 15G per season.

Q. Do not apply more than once per cutting. Do not cut or graze treated alfalfa within 7 days of application of ½ pint of Lorsban 4E per acre, within 14 days after application of 1 pint per acre, or within 21 days after application of rates above 1 pint per acre. Do not make more than 4 applications per year.

R. Apply Pounce 3.2EC prior to the brown silk stage. Do not apply more than 0.4 pound active ingredient of Pounce 1.5G per acre after the brown silk stage. Do not exceed a total of 1.0 pound active ingredient per acre per season.

S. Do not exceed 1.0 pound of active ingredient per acre per season for field and seed corn. Do not exceed 2 pounds of active ingredient per acre per season for popcorn.

T. Do not allow foraging and do not cut for hay within 14 days of last application by ground. Aerially treated pastures may be grazed or cut for hay on the day of treatment. Apply a maximum of 2 applications per year. Allow at least 14 days between applications.

U. Make no more than 1 foliage and 1 stubble application per alfalfa cutting.

V. Do not make more than one application over the plant.

W. Do not graze or feed soybean forage or hay. Do not apply more than 0.4 lb. active ingredient per acre per season.

X. Do not feed or graze livestock on treated plants. Do not exceed 0.2 pound of active ingredient per acre per season.

Y. Apply before heads emerge from boot. Do not make more than 2 applications per season. Do not feed treated forage to livestock.

Z. Do not use Furadan 4F as a foliar application if Furadan 10G, Furadan 15G, or Furadan 4F was applied to soybeans at planting time. Do not make more than 2 foliar applications per season. Do not graze or feed foliar-treated forage to livestock or cut for silage or hay.

AA. No more than 4 applications per season.

BB. Do not graze or feed treated crop to livestock.

CC. Do not apply more than 6 pints of Lorsban 4E per acre or 3 pounds of chlorpyrifos (active ingredient) per acre per season. Do not apply last treatment within 28 days before harvest or apply last 2 treatments closer than 14 days apart. Do not allow livestock to graze in treated areas or otherwise feed treated soybean forage, hay, and straw to meat or dairy animals. On determinate soybeans do not apply more than one application after pod set.

DD. Do not apply more than 9 pints of Lorsban 4E per acre per season. Do not allow livestock to graze in treated areas.

EE. Do not make more than 2 applications per season.

FF. Do not feed or graze livestock on treated plants. Do not exceed 0.8 pound active ingredient per acre per season.

* Use restricted to certified applicators only.

[a] Workers should be warned in advance of treatments. Workers may not enter fields treated with the insecticides without wearing protective clothing for the intervals indicated. They may not enter a field treated with other insecticides without protective clothing until the spray has dried or the dust has settled. Protective clothing includes a hat, long-sleeved shirt, full length pants, and shoes and socks.

[b] Sprays to be applied only by experienced operators wearing proper protective clothing.

Table 13. Relative Toxicities of Commonly Used Agricultural Insecticides

Trade name	Chemical class[b]	Chemical name	Toxicity to mammals[a] Acute oral	Acute dermal	Toxicity to Birds	Fish	Bees
*Aastar	OP,P	Phorate + flucythrinate	high	high	moderate	very high	moderate
*Ambush	P	permethrin	low	low	low	very high	high
*Asana	P	esfenvalerate	moderate	low	low	very high	high
Broot	C	trimethacarb	moderate	low	moderate	moderate	. . .
*Counter	OP	terbufos	high	high	high	very high	. . .
Cygon	OP	dimethoate	moderate	moderate	moderate	very low	very high
Diazinon	OP	diazinon	moderate	moderate	high	high	high
Dipel, Bactur, Topside, Thuricide, SOK	. . .	*Bacillus thuringiensis*	very low	very low	very low	very low	very low
*Dyfonate	OP	fonofos	high	moderate	high	very high	. . .
Dylox	OP	trichlorfon	low	low	low	very low	low
*Force	P	tefluthrin	low	low	low	very high	low
*Furadan	C	carbofuran	high	moderate	high	moderate	high
Imidan	OP	phosmet	moderate	low	moderate	moderate	very high
Lannate WSP	C	methomyl	high	moderate	low	moderate	high
Larvin	C	thiodicarb	moderate	low	low	moderate	moderate
Lorsban	OP	chlorpyrifos	moderate	moderate	moderate	very high	high
Malathion	OP	malathion	low	low	low	moderate	high
*Mocap	OP	ethoprop	moderate	high	moderate	. . .	moderate
Orthene	OP	acephate	moderate	moderate	moderate	low	high
*Penncap-M	OP	microencapsulated methyl parathion	moderate	low	moderate	very low	high
*Pounce	P	permethrin	low	low	low	very high	high
*Pydrin	P	fenvalerate	moderate	low	low	very high	very high
Sevin	C	carbaryl	low	low	very low	very low	high
*Supracide	OP	methidathion	high	moderate	moderate	high	high
*Thimet	OP	phorate	high	high	moderate	very high	moderate

* Use restricted to certified applicators only.
[a] Relative toxicities based on acute oral and acute dermal LD_{50} values of technical insecticide. Toxicities of formulated materials vary.
[b] OP = organophosphate, P = pyrethroid, C = carbamate.

Always read the label before applying insecticides.

WORKER REENTRY PERIODS IN FIELDS WHERE INSECTICIDES HAVE BEEN APPLIED

Most insecticide labels contain a statement about the length of time that should elapse before a person enters a treated field. The following is a summary of minimum field reentry times for insecticides commonly used in field crops. Follow label directions and do not enter treated fields without protective clothing until the reentry period has passed. Protective clothing is defined on most insecticide labels as a hat or other suitable head covering, a long-sleeved shirt and long-legged trousers or a coverall type garment, shoes, and socks.

Table 14. Worker Reentry Periods in Fields Where Insecticides Have Been Applied

Insecticide	Reentry statement on label
Aastar G	Do not enter treated areas without protective clothing until treatments have been completed.
Ambush 2E	Wait until spray is dry.
Asana XL	After spray has dried.
Broot 15GX	After dust has settled in treated field.
Counter 15G, 20CR	Do not enter treated areas without protective clothing until treatments have been completed.
Cygon 400	Wait four days, unless protective clothing is worn.
Diazinon AG 500	After spray is dry.
Dyfonate 4EC	Wait 24 hours, unless protective clothing is worn.
Dyfonate II 20G	Wait 24 hours, unless protective clothing is worn.
Force 1.5G	None specified on table.
Furadan 4F Furadan 15G	If prolonged intimate contact with corn and sorghum will result, do not reenter treated field within 14 days without proper protective clothing. For all other situations, do not reenter field less than 24 hours following application.
Imidan 50W	After spray has dried.
Lannate 90WSP	After spray has dried.
Larvin 3.2F	After spray has dried.
Lorsban 4E	Wait 24 hours, unless protective clothing is worn.
Lorsban 15G	None specified on label.
Malathion 57EC	After spray has dried.
Mocap 15G	After chemical has been mixed in soil.
Orthene 75SP	After spray has dried.
Penncap-M	Wait 48 hours.
Pounce 1.5G	None specified on label.
Pounce 3.2EC	After spray has dried.
Pydrin 2.4EC	After spray has dried.
Sevin XLR Plus	After spray has dried.
Supracide 2E	Wait 48 hours.
Thimet 20G	Do not enter treated areas without protective clothing until soil treatment is completed; 7 days for foliar application.

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